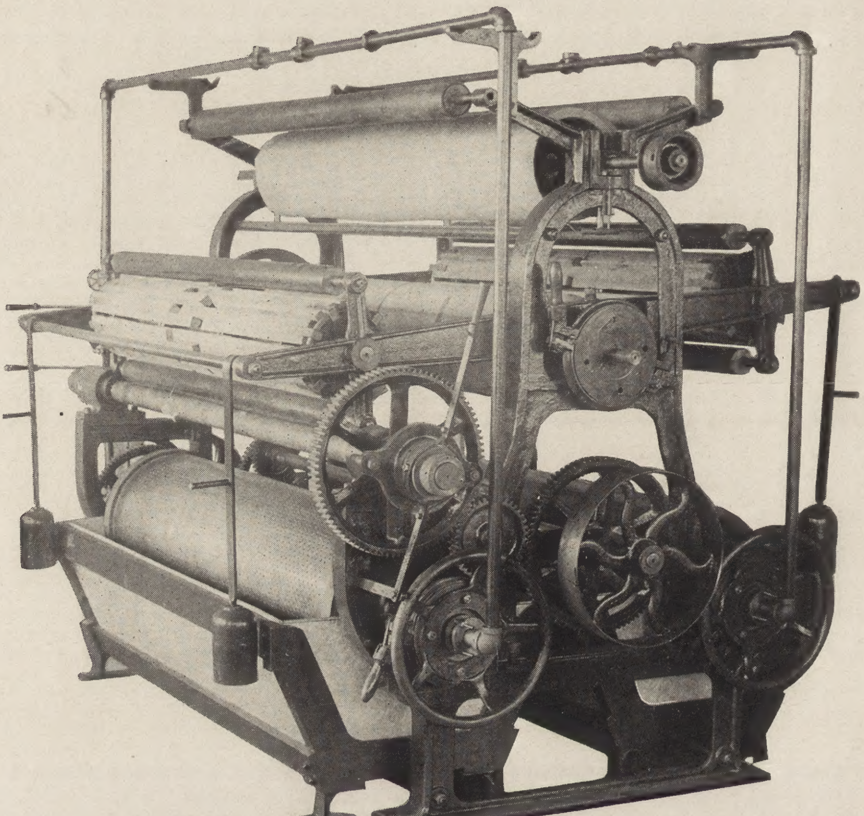

IMPROVED STEAM FINISHING MACHINE FOR WORSTEDS
Birch Brothers

Cyclopedia
of
Textile Work

A General Reference Library

ON COTTON, WOOLEN AND WORSTED YARN MANUFACTURE, WEAVING, DESIGNING, CHEMISTRY AND DYEING, FINISHING, KNITTING, AND ALLIED SUBJECTS.

Prepared by a Corps of

TEXTILE EXPERTS AND LEADING MANUFACTURERS

Illustrated with over Two Thousand Engravings

SEVEN VOLUMES

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Authors and Collaborators

FENWICK UMPLEBY

Head of Department of Textile Design, Lowell Textile School.

LOUIS A. OLNEY, A. C.

Head of Department of Textile Chemistry and Dyeing, Lowell Textile School.

M. A. METCALF

Managing Editor, "The Textile American."

H. WILLIAM NELSON

Head of Department of Weaving, Lowell Textile School.

JOHN F. TIMMERMANN

Textile Expert and Writer.
Formerly with Central Woolen Co., Stafford Springs, Conn.

WILLIAM R. MEADOWS, A. B., S. B.

Director, Mississippi Textile School.

MILES COLLINS

Superintendent of Abbott Worsted Co., Forge Village and Graniteville, Mass.

CHARLES C. HEDRICK

Mechanical Engineer, Lowell Machine Shop.

OTIS L. HUMPHREY

Formerly Head of Department of Cotton Yarn Manufacturing, Lowell Textile School.

C. E. FOSTER

Assistant Superintendent, Bigelow Carpet Co., Clinton, Mass.

Authors and Collaborators—Continued

WILLIAM G. NICHOLS

General Manufacturing Agent for the China Mfg. Co., the Webster Mfg. Co., and the Pembroke Mills.
Formerly Secretary and Treasurer, Springstein Mills, Chester, S. C.
Author of "Cost Finding in Cotton Mills."

B. MOORE PARKER, B. S.

Head of Department of Carding and Spinning, North Carolina College of Agriculture and Mechanic Arts.

I. WALWIN BARR

With Lawrence & Co., New York City.
Formerly Instructor in Textile Design, Lowell Textile School.

EDWARD B. WAITE

Head of Instruction Department, American School of Correspondence.
American Society of Mechanical Engineers.
Western Society of Engineers.

WALTER M. HASTINGS

Assistant Agent, Arlington Mills, Lawrence, Mass.

GEORGE R. METCALFE, M. E.

Head of Technical Publication Department, Westinghouse Elec. & Mfg. Co.
Formerly Technical Editor, Street Railway Review.
Formerly Editor of Text-book Department, American School of Correspondence.

ALFRED S. JOHNSON, Ph. D.

Editor, "The Technical World Magazine."

HARRIS C. TROW, S. B.

Editor of Text-book Department, American School of Correspondence.
American Institute of Electrical Engineers.

CLARENCE HUTTON

Textile Editor, American School of Correspondence.

Authorities Consulted

THE editors have freely consulted the standard technical literature of Europe and America in the preparation of these volumes and desire to express their indebtedness, particularly to the following eminent authorities, whose well known treatises should be in the library of every one connected with textile manufacturing.

Grateful acknowledgment is here made also for the invaluable co-operation of the foremost manufacturers of textile machinery, in making these volumes thoroughly representative of the best and latest practice in the design and construction of textile appliances; also for the valuable drawings and data, suggestions, criticisms, and other courtesies.

WILLIAM G. NICHOLS.

General Manufacturing Agent for the China Mfg. Co., the Webster Mfg. Co., and the Pembroke Mills.
Formerly Secretary and Treasurer, Springstein Mills, Chester, S. C.
Author of "Cost Finding in Cotton Mills."

THOMAS R. ASHENHURST.

Head Master Textile Department, Bradford Technical College.
Author of "Design in Textile Fabrics."

J. MERRITT MATTHEWS, Ph. D.

Head of Chemical and Dyeing Department, Philadelphia Textile School.
Author of "Textile Fibers," etc.

J. J. HUMMEL, F. C. S.

Professor and Director of the Dyeing Department, Yorkshire College, Leeds.
Author of "Dyeing of Textile Fabrics," etc.

WILLIAM J. HANNAN.

Lecturer on Cotton Spinning at the Chorley Science and Art School.
Author of "Textile Fibers of Commerce."

ROBERTS BEAUMONT, M. E., M. S. A.

Head of Textile Department, City and Guilds of London Institute.
Author of "Color in Woven Design," "Woolen and Worsted Manufacture."

JOHN LISTER.

Author of "The Manufacturing Processes of Woolen and Worsted."

Authorities Consulted—Continued

W. S. BRIGHT McLAREN, M. A.

Author of "Spinning Woolen and Worsted."

CHARLES VICKERMAN.

Author of "Woolen Spinning," "The Woolen Thread," "Notes on Carding," etc.

WILLIAM SCOTT TAGGART.

Author of "Cotton Spinning."

HOWARD PRIESTMAN.

Author of "Principles of Wool Combing," "Principles of Worsted Spinning," etc.

H. NEVILLE.

Principal of Textile Department, Municipal Technical School, Blackburn.
Author of "The Student's Handbook of Practical Fabric Structure."

FRED BRADBURY.

Head of Textile Department, Municipal Technical Schools, Halifax.
Author of "Calculations in Yarns and Fabrics."

E. A. POSSELT.

Consulting Expert on Textile Manufacturing.
Author of "Technology of Textile Design," "Cotton Manufacturing," etc.

H. A. METZ.

President, H. A. Metz & Co.
Author of "The Year Book for Colorists and Dyers."

T. F. BELL.

Instructor in Linen Manufacturing, etc., City and Guilds of London Institute.
Author of "Jacquard Weaving and Designing."

M. M. BUCKLEY.

Head of Spinning Department, Halifax Municipal Technical School.
Author of "Cone Drawing," "Worsted Overlookers Handbook," etc.

FRANKLIN BEECH.

Author of "Dyeing of Woolen Fabrics," "Dyeing of Cotton Fabrics," etc.

Authorities Consulted—Continued

WALTER M. GARDNER, F. C. S.

Professor of Chemistry and Dyeing in City of Bradford Technical College.
Author of "Wool Dyeing," etc.

ALBERT AINLEY.

Author of "Woolen and Worsted Loomfixing."

G. F. IVEY.

Author of "Loomfixing and Weaving."

ERNEST WHITWORTH.

Formerly Principal of Designing and Cloth Analysis Department, New Bedford Textile School.
Author of "Practical Cotton Calculations."

DAVID PATERSON, F. R. S. E., F. C. S.

Author of "Color Printing of Carpet Yarn," "Color Mixing," "Color Matching on Textiles," etc.

Introductory Note

THE Cyclopedia of Textile Work is compiled from the most practical and comprehensive instruction papers of the American School of Correspondence. It is intended to furnish instruction to those who cannot take a correspondence course, in the same manner as the American School of Correspondence affords instruction to those who cannot attend a resident textile school.

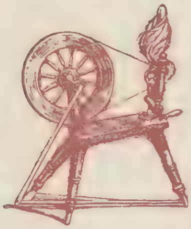
¶ The instruction papers forming the Cyclopedia have been prepared especially for home study by acknowledged authorities, and represent the most careful study of practical needs and conditions. Although primarily intended for correspondence study they are used as text-books by the Lowell Textile School, the Textile Department of the Clemson Agricultural College, the Textile Department of the North Carolina College of Agriculture and Mechanic Arts, the Mississippi Textile School, and for reference in the leading libraries and mills.

¶ Years of experience in the mill, laboratory and class room have been required in the preparation of the various sections of the Cyclopedia. Each section has been tested by actual use for its practical value to the man who desires to know the latest and best practice from the card room to the finishing department.

¶ Numerous examples for practice are inserted at intervals. These, with the test questions, help the reader to fix in mind the essential points, thus combining the advantages of a textbook with a reference work.

¶ Grateful acknowledgment is due to the corps of authors and collaborators, who have prepared the many sections of this work. The hearty co-operation of these men — manufacturers and educators of wide practical experience and acknowledged ability — has alone made these volumes possible.

¶ The Cyclopedia has been compiled with the idea of making it a work thoroughly technical, yet easily comprehended by the man who has but little time in which to acquaint himself with the fundamental branches of textile manufacturing. If, therefore, it should benefit any of the large number of workers who need, yet lack, technical training, the editors will feel that its mission has been accomplished.



Contents

VOLUME VII.

* For Page numbers see foot of pages.

IMPROVED FULLING MILL FOR WOOLEN GOODS
James Hunter Machine Co.

WOOLEN AND WORSTED FINISHING.

PART I.

WET FINISHING.

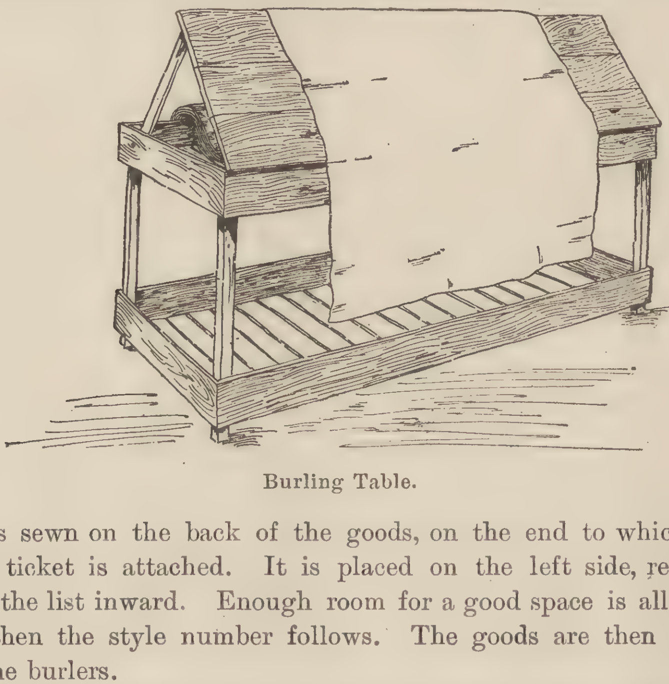
"Finishing" includes all the various processes through which goods pass, from the time they leave the loom until they are packed in cases and sent to market.

It is divided into two separate departments, viz.: the "Wet Finishing" and the "Dry Finishing," each of which is further subdivided into the different processes, forming their respective departments. The preparatory process, although performed on the goods in the dry state, is not regarded as being part of the dry finishing, nor yet as part of the wet finishing, but is usually treated as a separate department, although in small mills the finisher has charge of this work.

Inspection. The first process consists of the inspection of the goods, after which the number and style are sewn on them. The goods are carefully inspected to find all imperfections, no matter what the cause may be, and to properly mark them with chalk. The goods are generally inspected in the weave room, but the examination there is generally superficial, and simply for the purpose of seeing that the weaver's work has been done properly. But the inspection referred to here must be more thorough, as it is for the purpose of finding all the small imperfections—those which are easiest overlooked and which as a rule cause the most claims from the buyers. A small "thread out" for a quarter of an inch or more, is usually considered such a small matter that no notice is taken of it at the weave-room examination, but when the goods are taken to the finishing room all these little things must be remedied in order to produce a piece of cloth as nearly perfect as possible. It is a very hard matter at best to produce a piece of cloth which is in every respect perfect, and with which some one so disposed could not find fault, but it should be the ambition of the finisher to come as near perfection as is compatible with trade conditions. These small imperfections can in many instances be finally remedied by an expert

fine-drawer, but it will take less labor and entail less expense to look after these small things from the start. It may be stated here that in most small mills this inspection is about all the goods receive before the final inspection of the finished fabric; but the finer the goods, the more important this labor becomes. The first is followed by a second and sometimes by a third inspection before the goods are allowed to pass to the wet finishing department.

After this first step is completed the pieces are marked by sewing on the number and style. Sometimes the yards and weight from the loom are also sewn on them, although for all practical purposes the latter may as well be omitted. The num-



Burling Table.

ber is sewn on the back of the goods, on the end to which the loom ticket is attached. It is placed on the left side, reading from the list inward. Enough room for a good space is allowed, and then the style number follows. The goods are then ready for the burlers.

Burling. Here the goods are drawn over a table whose top has hinges on the side nearest the operator, so that it may be elevated to an angle of 45° by means of a stick put under the back. This top must be well joined and smooth, so that the burlers may readily feel each knot and bunch in order to remove them. The table tops are sometimes covered with zinc, but the constant

drawing of the goods over them wears the zinc, until it becomes worn through, and being thin is likely to cut the goods. Smooth, well-joined boards, shellacked, will be found satisfactory.

The burlers commence on the back of the goods and remove all bunches, knots and loose ends; in fact, everything which in any way interferes with the smoothness of the surface. For this work "burling irons" are employed, of which there are several styles; the old-fashioned, pointed irons are still preferred, however, to all others. With these and a pair of scissors the work can be well done. The knots should be drawn to the surface carefully, and cut off, but not too short. The threads must not be unduly tightened when the knots are drawn out, or they will crawl back and thus leave an imperfect place. While generally this is not of as much importance on the back as it is on the face, still it should be insisted on, for it does not take any longer, and prevents the operative from getting into slovenly habits, which are often continued when burling the face. As soon as the back has been burled in a careful manner, the face is taken and treated in the same way.

Each burler should be provided with a piece of chalk, so that if an imperfection is seen which has slipped by the inspector, it may be marked, thus aiding his labors. The inspector necessarily pulls a piece over faster than the burler, and therefore the latter is likely to catch everything which slips by, if she is properly instructed. The whole work must be done on the face in a very careful manner, especially in drawing out bunches. These should be drawn out a little at a time, so as not to injure the threads. On close-finished goods the knots are drawn to the surface and left there for the shears to cut.

The greatest trouble met with on the face is caused by runners. These are made by the drawing in of the filling on the sides of the goods all the way from one to five inches, and sometimes even more. This imperfection is generally due to poor loom fixing, and is not allowed to happen in many places. Runners must be drawn out carefully, the work being intrusted only to experienced hands, else more harm than good will result. If not carefully done, the menders must do much additional work. When the piece has been carefully treated in the manner described,

the burlers enter the number and style, together with the date, in a passbook given them for this purpose. This shows the amount of work performed, and also helps to locate blame, if any complaint arises on account of poor work. They then fold up the piece neatly and place it on the pile for the next operation, which is usually the mending. This folding of the pieces is often overlooked for the purpose of saving time, but much to the detriment

Cloth Room Perch.

of the appearance of the room. Neatness is one of the great helps in finishing, and should be practised from start to finish.

Mending. On the finer grades of goods, such as cassimeres, fancy worsteds, etc., there is a second inspection before the mending. The goods are pulled over what is termed a "perch," which consists of two rolls suspended from the ceiling to within 7 or $7\frac{1}{2}$ feet of the floor. The rolls are about four feet apart, so

that the inspector can stand between them, and passing the goods over these rolls, pull the cloth down between himself and the light. He will thus discover any imperfections which have so far escaped notice. The light for this work should be strong, for under the most favorable circumstances it is difficult for even a painstaking man to find all the imperfections. It must also be borne in mind that the goods will receive as close an examination from the buyer as at the mill, and therefore good light should be furnished the inspector. A strong north light, with extra large windows, will be found excellent, and attention should be paid to this matter at this stage. This inspection serves the purpose of examining the burler's work, and to mark everything so that the menders may not lose time hunting for "bad places." The inspector should have a knowledge of weaving, as this will enable him to know what can be properly mended and what cannot. He must have some kind of system by which the menders may know of his intentions without asking questions. For instance, marks indicate places to be mended; if, however, a bad place appears that cannot be properly mended, a cross is made over it, so that the menders will not waste time in trying to mend it. The knowledge of weaving or of the construction of cloth will enable the inspector to save much labor in obliterating a misspick by cutting certain threads, but unless one is sure what threads to cut it is better not to attempt it.

After this inspection, the goods are ready for the menders. Usually the pieces are drawn over a perch provided for each mender, as it is much better and easier than to pull the pieces over a table; moreover, the operator has a chance to look through the goods and see if she is doing the work properly. Menders must have good eyes and be able to imitate closely, for upon this depends their value. They must be capable of repairing each place so that it will be as good as the rest, otherwise the work will be of little use. It takes an expert needlewoman, and to whom a knowledge of weaving is usually of great assistance. The menders work all over the piece, so that when it leaves their hands it should be perfect, or very nearly so. They also fold each piece neatly and enter it in their book, placing the piece in the place designated for the goods that are ready for the next step.

Tacking. Next in order is the "tacking," which is accom-

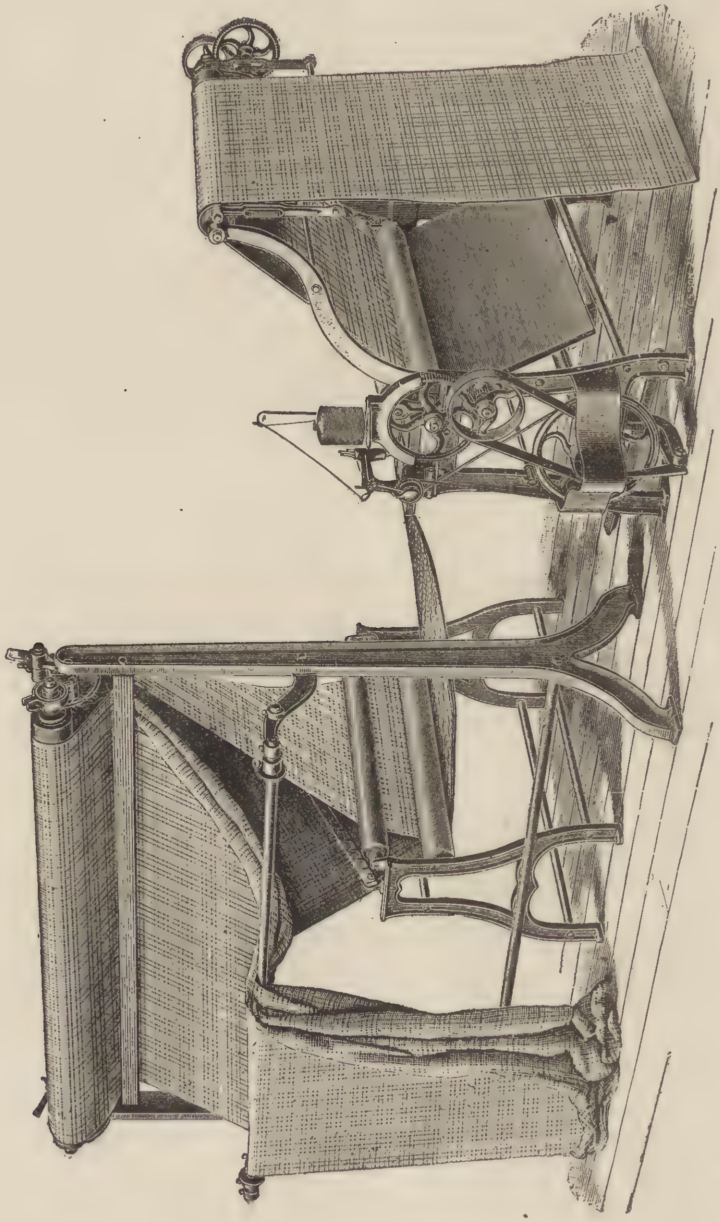


Fig. 1. Tacking Machine.

plished by doubling the piece face in and sewing the lists together every three or four inches. In many mills machines are in use for this purpose, but as tacking is not resorted to in all cases, there are probably as many more places where this work is done by hand. Fig. 1 illustrates a machine of this kind. As will be seen, the goods pass over a roll to which friction may be applied, are then doubled, and thus pass to the sewing-machine, where the lists are stitched together with large stitches from 1 to $1\frac{1}{2}$ inches in length. The piece then passes through two rolls, which draw it along, taking the place of the feeder, as found on all sewing-machines. It is then passed over a top roll to a folder, which folds it off neatly back of the machine. Tacking is employed on goods where the lists are faultily constructed, causing them to roll up in the fulling; also to protect the face of fine goods from chafing, and lastly wherever flocks are used in the fulling process.

FULLING.

Theory. The next step in the process is the "fulling," and with this the wet finishing department is entered. "Fulling" consists of the felting together of the various fibers of which the fabric is composed, not only to give the fabric added strength, but also and chiefly to lay the proper foundation for the finish which the goods are to receive. This department should be well understood, as it is of the utmost importance to the entire finishing process. In many cases the fulling does not seem to amount to more than getting the goods to the correct width and length, thus insuring the right weight, but there is considerably more to it. The whole process rests upon the peculiar property of the wool fiber; something which cannot be found in any other fiber that is capable of being spun into a thread. This is the felting capacity. Under the microscope the wool fiber reveals itself as covered with a sort of minute scale. In the process of fulling these seem to contract, and hold other fibers which in the process are pressed upon them. In order to bring about this "felting together" of the fibers three agencies are required: "pressure," "moisture" and "heat." By far the most important of these agencies is moisture, and therefore this will be considered first.

Simple moisture, as supplied by water, will no doubt, com-

bined with other agencies, call into action the felting capacity of the fibers, but it has been found that if nothing else is used, the process will be extended not only beyond the limit where it is profitable, but in many instances where it is safe to go. It is customary to use soap as the moistening agency. The clean wool fiber will felt in hot water to which a quantity of sulphuric acid has been added, provided pressure is employed, but the great drawback to this is that it leaves the fiber in a harsh and brittle condition, which is not desirable to have in woolen goods. Soap, however, has a tendency to soften the wool fiber, and as it contains alkali, which is also an aid to felting, it is by all means the best material to supply the moisture needed for the purpose. That alkali aids the fulling in a marked degree may be seen by the fact that a clean piece of cloth fulled with a neutral soap will take an extraordinary length of time to be brought to width and length. In point of felting, however, it will be found that the neutral soap will give superior results; and this shows conclusively that while alkali aids the fulling in point of time, it does not give as good results as a neutral soap.

Construction of Mill. The next agency employed in fulling is pressure; this is supplied by what is termed the mill, one form of which is shown in Fig. 2. The fulling mill is composed chiefly of sets of rolls, one on top of the other, the lower one usually having flanges. Two of the flange rolls are mounted firmly on a shaft and set into a framework, the power being applied at one end of the shaft, just outside of the framework. Two rolls without flanges, also mounted firmly on a shaft, are placed on top of the first two in such a manner that the top rolls will run inside the flanges of the lower ones. On the opposite side from where the power is applied, these two sets of rolls are united by two long-toothed gears, which insure the top roll turning the same as the bottom, thus preventing unnecessary friction. The journals of the top roll are movable, and slide up or down in a slot in the frame.

In order to obtain the required pressure, the top rolls have a set of elliptical springs on the journal box, which may be drawn down to any desired pressure by means of rods threaded on one end and passing through a hole in the frame. The whole is

boxed in with good, smooth, hard-pine planking, the top being in sections and on hinges, so that it can be easily removed, if necessary. Between the two sets of rolls a partition is placed so that one machine consists practically of two fulling mills. In the front part of the machine throat plates and guide rolls are fixed, through and over which the goods pass when the machine is set in motion. The ends of the goods are sewn together, and an endless string is thus made, which is continually moving.

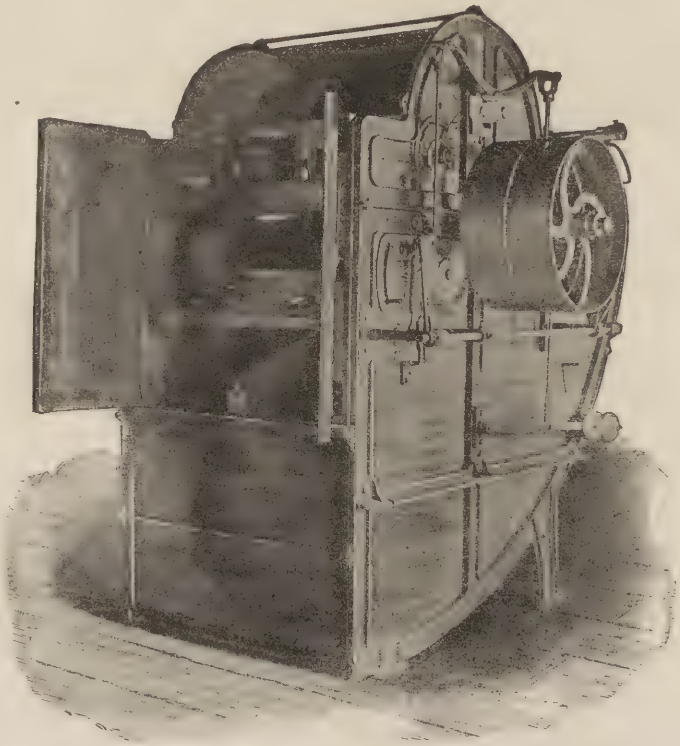


Fig. 2. Fulling Mill.

As this apparatus exerts pressure on the goods only sideways, it would be found that they would come out of the mill longer than when they were put in. This is due to the fact that the weight of the goods has a tendency to stretch them as they are pulled rapidly through the throat plates and slide along the bottom of the mill.

Regulation of Traps. In order to shrink the goods in length

as well as in width, a box is attached back of the rolls, through which the cloth slides as it leaves the rolls. This box has a cover which may be let down on the goods, and in this way hinder their free passage. A new supply coming constantly into the box from the two rolls will crowd and press the goods together until the cover is lifted enough to allow a portion of the piece to fall to the bottom of the mill. This cover is securely fastened to a rod, which extends to the outside of the frame, and which has here an arm attached in the same position as the cover. To this arm a rod is fixed, on which weights may be placed, thus giving additional pressure to

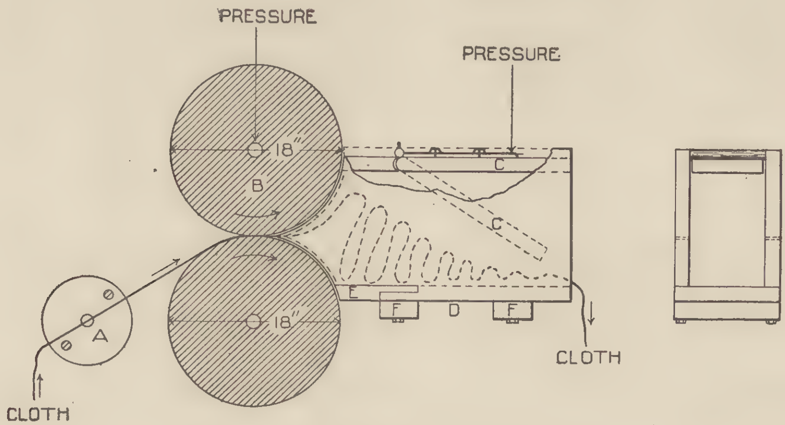


Fig. 3. Cross-section of Fulling Mill.

the cover, and in turn requiring more pressure from the cloth, to lift it. In this way the pressure is applied lengthways. This is called the *crimping-box*, or trap. Fig. 3 shows the running of the cloth through the rolls and trap, the bottom of the mill being omitted. In front of the rolls is a guide A, made of bronze, consisting of two bronze discs nine inches in diameter, the inside edges being rounded. At the two dots between which the cloth passes are two bars (bronze) which pass from one disc to the other. The discs are mounted on shafts, one end of which projects outside of the mill and may be turned, so as to have the bars hold back the cloth, thus causing stretch. It is therefore called the stretcher. Many mills are not supplied with this device, for it is not a necessity, but very useful at times. From the stretcher the cloth passes to the rolls, the upper of which is lettered B; in some

mills an extra throat plate immediately in front of the rolls is placed. The diameter of the fulling mill rolls varies considerably, but eighteen inches is a fair average. As the cloth passes into the box (trap) the cover C bears on it and causes it to accumulate somewhat in the manner indicated. When quite an amount has gathered, the pressure of the cloth lifts the cover and allows the cloth to drop to the bottom of the mill. The side pieces of the trap are made to fit snugly to the rolls. The bottom of the box is about five inches lower than the top of the lower roll. On the end next to the roll is a shoe of bronze, E, securely fastened to the bottom board. Two stout pieces of plank (F F) are placed across the mill and support the box. The bottom is fastened to them. The box is made of $1\frac{1}{2}$-inch plank. The end view of the trap is shown on the right of cut. Arrows indicate the direction in which the cloth travels.

In the actual work of running pieces in the mill the following will serve as a guide: two pieces are selected as nearly alike as possible in point of weight and length. This is done for the purpose of having both sides come out as nearly alike as possible. If one piece should be six or eight yards longer than the other, it will take more time to full the longer piece than the shorter, thus causing one side of the mill to run empty while the other piece is still coming up. Running mills one-sided causes much pounding, is harmful to the machinery, and should be avoided whenever possible.

The manner of obtaining the third agency, "heat" is described on page 16.

The fuller takes off the loom ticket and compares the number on it with the number sewn on the piece, to see if they correspond; this is to prevent mistakes. The ticket is hung on a nail or peg on the side of the mill where the piece is to run. He then takes the end and brings it over the guide rolls and through the throat-plate and pushes it into the bite of the rolls. When this is done with both sides, he starts the mill and runs the goods in until just before the other end comes around. The end is then taken from the bottom of the mill, and the two ends are firmly and neatly sewn together. If sewing-machines are employed for this purpose, the ends should be placed back to back so as to make the seam on

the face; the back is then turned out, and the ends of the seam are inside. This will make things run smoother, and will prevent the heavy pounding which is heard every time it passes through the rolls, when the seam is outside. The pieces are run for a minute to see that they go smoothly, and are then soaped.

Soaping. In soaping the goods considerable care is necessary to have the work uniform. Many different ways are adopted to attain this result. To pour the soap on in a slow and steady stream is perhaps the best. The amount of soap put on the goods to properly wet them is of the first importance. Uniform results cannot be obtained, no matter in what way the soap is applied if the amount is insufficient. On the other hand, if the amount of soap which the goods require is given, such a thing as uneven soaping cannot take place, no matter how the soap is put on, even if it were all dumped on the goods in one place and at one time. As it is practically impossible to tell just to a nicety how much soap is required, it is best to pour steadily and evenly all over the pieces, and after running awhile, stop and examine them, to see if they are sufficiently soaped. This is done by twisting the piece to see how much moisture shows. By wringing an end of the cloth tightly, moisture should appear in such quantity as to run off, but it should require a good twisting to show this. Also try the goods at different places, and if they show all alike and sufficient moisture, start up the machine and let the goods run; if not, add a little more soap, as the case seems to require. Actual experience is necessary, and no hard and fast rules can be laid down.

When stopping to examine the goods, all the soap which has spattered on the wood and other stationary parts should be removed and put back on the pieces. By doing this the mill is always kept in good condition, and will last a good deal longer than if this soap were allowed to stay on and harden. The doors will shut better, and the hinges will last longer; in fact, the whole machine is better for it. After these little things have been attended to and the goods are running in the mill, the fuller will have time to attend to other duties; and if more than one mill is running, he can give his attention to the rest. Before leaving the mill, however, he should mark the time of starting on the back of

the ticket, so that he can always know how long the goods have been running in the mill. When they have run for about ten minutes, it is time to put on the trap and commence to crowd them lengthways. During the time that everything is in operation he should look to the cleanliness around the mills, for it should be the aim of the fuller not only to keep the inside of the mill in good condition, but to have the room tidy also. It may be stated as a fact, that a man who neglects to keep the floor around the mill clean, will neglect other and perhaps more important matters also, and therefore will bear close watching. However good a man may be, it can hardly be said that the man who needs watching is just the right kind of a man to have around, but as other things often have to be taken into consideration, it may not be desirable to part with him.

Uneven fulling having been shown above as due to insufficient soaping, the opposite of this, excessive, or over-soaping, must next be considered. If too much soap is used, the goods will consume too much time in getting warm, for the soap will make them slide along too smoothly. As felting does not take place until they get warm, too much soap hinders in this way, if in no other. But there are other evils which are the result of too much soap. It causes the goods to feel slazy and too soft, and lack entirely the substantial feeling of a well-finished fabric. Then again, the goods cling to the bottom roll, and are often carried around with it, doing great damage and causing much labor to get them straightened again. As the lower part of the trap is set close to the bottom roll, it is provided with a bronze shoe, for wood would wear out too fast. Now if the goods cling to the roll until they get to this shoe, small, three-cornered holes are often torn in them in taking the piece from the roll. These may easily be detected as due to too much soap, for they are always of the same nature, and the piece will hang to the roll to such an extent that they can hardly be mistaken as having been caused elsewhere. When the piece has too much soap the trouble can best be remedied by taking a dry piece which is ready for the fulling mill, and running it through on top of the piece which has too much soap. This will absorb enough to leave the goods in the right condition. If it is found that once running through does not remedy the matter sufficiently,

repeat the operation until the goods in the mill have had sufficient soap removed.

The soaping-machine, which has of late years come into use, is a great help in making even applications, for the goods will be soaped properly with this machine, and at a great saving of material. This machine is simple and easily constructed. It

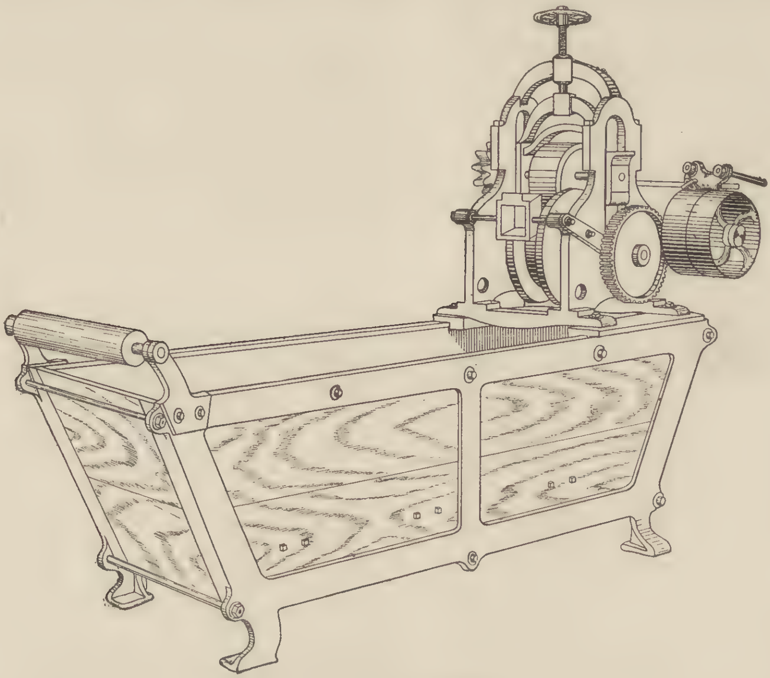


Fig. 4. Soaping Machine.

consists of a soap-tank, in which the goods are immersed, and a pair of squeeze rolls or mammoth wringer, through which they pass, thereby squeezing out all surplus soap and leaving them in good condition for fulling. See Fig. 4.

Heat. Thus far the last agency employed in fulling has not been discussed, that is, heat. In fulling, the moisture and pressure are supplied, but the heat generates itself in the process by means of friction. While it is a necessary factor in fulling, it must nevertheless be closely watched, for too much heat, especially that generated by friction, will speedily weaken the fiber to such an extent that the goods, instead of coming from the mills in

good condition, will be tender and practically useless. Therefore this point must be watched closely, and if too much heat is generated, fresh air should be let in to force out the heated air and thus keep the temperature down. When pieces get hot the moisture evaporates rapidly, and frequent examinations should be made to see that they do not get too dry. A little fresh soap added to keep the moisture at the right point, will lubricate the goods and also keep down the heat.

Generally cloth shrinks faster in length than in width, but this is not always the case. As the shrinkage lengthways is controlled by the trap referred to, a question arises as to the best time to apply this pressure. The aim should be to bring the goods up both in width and length at the same time, for if they come up faster in width than in length, they will undoubtedly be too narrow when they are shrunk sufficiently in length. If, however, the goods come up faster in length than in width, some of the weight can be taken off, thus easing the shrinking process. However, it will not do to take the trap off wholly, for then the goods will begin to stretch, and being warm will quickly lose all that has been gained in shrinkage. Therefore, if the goods do not shrink fast enough in width, put more pressure on the springs; or if this should not seem advisable, crowd the pieces more in the rolls. This latter is done by taking out each piece and running it in again about one-half; then take the end and bring it over the guide roll and fold it in the piece as it runs into the rolls, start the machine and run it until the end comes around; then take the end wrapped in the piece and sew both ends together, thus doubling the cloth and making it run as though two pieces were in the mill. This increases the pressure, and as the piece takes only half the time to run around, the capacity for shrinking is doubled. On long cuts this can be continued by running in one-third of the piece and folding the end in the cloth and tying it. Run in the piece to the end and it will be found that three thicknesses are under the roll.

When the goods have been shrunk both in width and length, and just before they are taken from the mill, give each one a dipperful of fresh soap, to aid in the washing; then run until the seam comes to the front; cut it, start up and run until the whole

piece has passed through the roll; then stop the machine, lift off the cover of the trap, and fasten it so that it will stay up. Take the pieces from the mill, having first seen that another set are ready to put in.

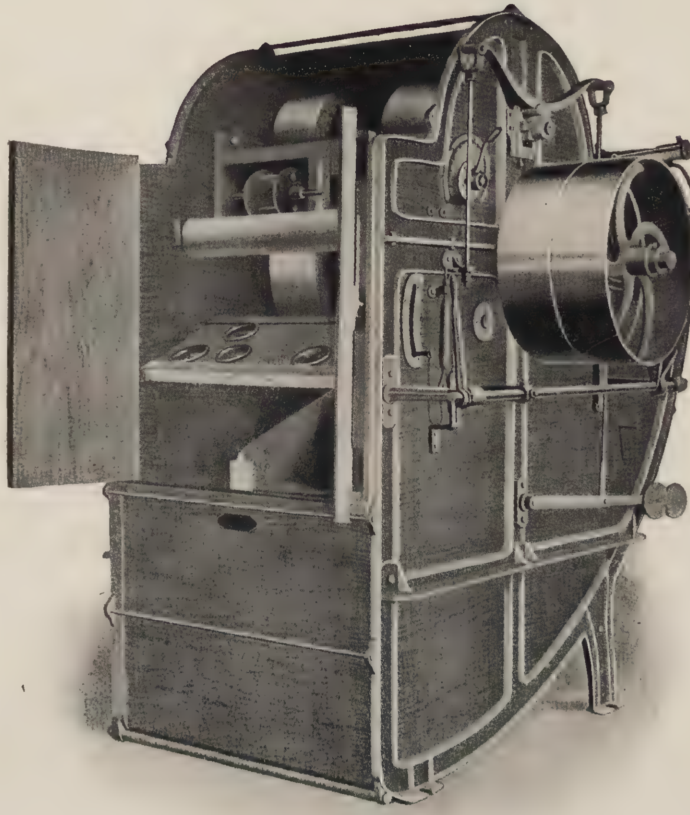
The tacking strings should be immediately removed and the goods opened out, so that the air can get to them. This is especially necessary where they cannot go directly into the washer, for it will not do to let them lie in hot piles any length of time. To be very exact and do everything in a sure and safe manner, the goods should be opened out and perched before another set is put in the mill. This is done to detect damages if there are any, for nuts and bolts may loosen, and wood is likely to wear, each of which may cause much trouble. If goods are perched before the mill is started again, the cause of these imperfections may be ascertained and remedied before further harm is done.

As soon as the pieces are out of the mill, and before another set is started, the fuller takes the tickets and enters them in a book, for future reference. The date, number, style, yards and weight from loom, the number of mill and side of same, amount of shrinkage, both of width and length, and running time in the mill, should be entered. When done properly and carefully it will be found of great assistance in determining the treatment of goods of the same style at some future time, and will also form a record of the treatment of goods each day. A convenient form of record is as follows:

Date.	Number.	Style.	Yds. from.	Wt. Loom.	W. Mill.	Shrunk inches.	Width.	Time.	Remarks.
1902.									
Apr. 5	1672	253	48^1	20^1	4 R.	3	56	3½	Mill holes
	1851	253	48^3	20^5	4 L.	2½	56	3½	
	1942	265	46^3	16^4	3 R.	2	56½	2½	
	1282	265	46	16^5	3 L.	2	56	2½	

EXERCISES FOR PRACTICE.

1. How should knots be treated on close-finished goods?



IMPROVED ROTARY FULLING MILL
Rodney Hunt Machine Co.

2. What is the advantage derived from thorough inspection?
3. Describe the fulling process concisely in your own words, giving the manner of regulating the shrinkage.
4. When should places not be mended?
5. What practical purpose does inspection serve?
6. When and where should it be employed?
7. Which is the best way of tacking, aside from machine work?
8. What are runners?
9. In what ways can burlers aid the inspector?
10. What especial ends does the record of the fuller serve?
11. Give a brief sketch of matter so far studied, touching all points of importance.

Shrinkage. The estimation of the loss sustained in the finishing process is one of the most important questions which come to the finisher in all his labors; this is especially true when he has before him a new range or a new class of goods. From the start he should consider carefully all questions pertaining to the different processes and the relative influence of these processes upon the fabric, so that he can intelligently provide for the losses the goods are sure to sustain. The finisher is well aware that the goods as they come from the weave room will lose a certain percentage of their weight in the process of finishing (this cannot be avoided), but in order to produce the desired article, judgment must be used to provide for all these losses before the actual work begins.

Experience alone will enable a man to estimate what the loss is likely to be, and unless he can estimate this, his labors are likely to prove unsuccessful. The loss, properly speaking, is not confined to weight alone, although this is very perceptible. For instance, the loss sustained to the nap of the goods is an item of great importance and must be carefully considered. The finisher should be able to judge by the make-up of the goods how much gigging its surface will stand, provided the proper foundation is laid in the fulling mill, and he must be able to produce that foundation. It is from the clean weight of the fabric that all future calculations must be made. To this is to be added the loss

sustained in fulling, which is the largest that the fabric has to bear in the entire process.

Aside from the amount of dirt, grease and other foreign matter which is loosened but not removed in the fulling, there is a large loss due to the wear and tear of the process. How large this is, may be determined by taking a piece well scoured and cleansed and then fulling it in a perfectly clean mill. When the process is completed it will be found that quite an amount of stock has gathered on all projections, as well as at the bottom of the mill. This takes place under any and all conditions, and cannot be avoided; therefore, it must be provided for beforehand. In the scouring or washing, the grease and other matter loosened in the fulling is here finally removed, and the loss here consists also in a certain amount of stretch, caused by the running of the goods in the washer. The gigging, coming next, reduces the weight by the removal of the short fibers, which are not sufficiently felted to stand the strain. The pulling out of a certain amount of felted fibers also takes place. No matter how carefully the gigging is conducted this cannot be avoided, for one of two things is sure to happen: the fiber or the teasel point will give way; and it is only a question of which can best stand the strain. The ability to withstand the strain is about evenly divided, for there will be as many teasel points broken as fibers pulled out. Although this is a necessary adjunct of the gigging or teaseling process, the loss sustained must be taken into account and provided for.

The loss in shearing seems larger than it actually is, but still is large enough to merit attention. The different stretchings the goods receive as they pass over the various machines all tend toward creating a loss, and one and all must be taken into consideration before proceeding to full the goods.

The causes for loss enumerated are due chiefly to the process of finishing, but there are other causes outside of the finishing department which have a bearing upon the question. The amount of oil used on the stock, as well as the quality and condition of same at the time of using, will affect the greasy state of the goods. The color also exerts its influence; for dark-colored goods generally lose more than the lighter shades. It is safe to say that in general the loss on woolen goods from all sources will range from

10 to 25 per cent, and on some goods even more than the latter figure.

As soon as the per cent of probable loss has been determined, calculate the shrinkage. One yard usually forms the basis of all calculations; for if one yard is fulled and shrunk properly, it follows that the rest will act in a similar manner. Therefore, one yard is marked off on the end of the cut, about a yard from the seam. This makes it easier to determine when goods have shrunk sufficiently, and is safer than measuring the whole piece.

Calculation. An example of determining the shrinkage required to bring the goods to the right weight is as follows: A piece of cloth is received in the finishing room weighing 26 ounces "from the loom," and it should weigh 24 ounces per yard when it is finished. The loss sustained during the process is estimated at 20 per cent. In order to find how much the piece would weigh if it were not shrunk, we proceed as follows: 26 ounces $\times .20 = 5.2$ ounces; that is, multiply the weight by the per cent of loss. Subtracting the 5.2 ounces from the 26 ounces would give 20.8, this being the weight of the goods without shrinkage. Here we have practically two problems in arithmetic, which may be combined into one problem by multiplying the 26 ounces by the remaining .80, as follows: $26 \times .80$, which gives us 20.80, the same as the two processes given above. Then comes the question, if 1 yard, or 36 inches, weighs only 20.8, which is 3.2 ounces less than what the goods are required to weigh, how many inches would this yard represent of 24 ounces, and to what point must each yard be shrunk to have the whole piece weigh 24 ounces to the yard? To find this, multiply the actual weight, 20.8, by 36 inches, and divide the product by 24, the weight wanted per yard. Thus: $(20.8 \times 36) \div 24 = 31.2$, or $\frac{20.8 \times 36}{24} = 31.2$. Therefore, it is found that each yard has to be shrunk until it measures 31.2 inches in order to have the whole piece weigh 24 ounces to the yard. If cancellation is employed, the whole figuring process may be done in one example by putting all the figures which have to be multiplied above the line and the divisors below, as follows:

$\frac{26 \times 80 \times 36}{100 \times 24} = 31\frac{2}{10}$, as above. 31.2 subtracted from 36 gives 4.8 inches to be shrunk per yard. The latter method is to be preferred, and should be well studied. The following rules govern the different processes :

To find amount of loss, multiply the gross weight by the per cent of loss.

To find clean weight, subtract amount of loss from gross weight.

To find shrinkage required, multiply clean weight by inches in one yard and divide by weight wanted.

To find clean weight by one process, multiply gross weight per yard by the clean weight expressed decimally, thus .80.

To perform all the three operations at once, proceed as follows: Multiply gross weight by clean weight expressed decimally, and this by inches in yard (36), and divide by 100 multiplied by the weight wanted.

The foregoing examples cover only those goods where the shrinkage alone is relied upon to make correct weight. This is the simplest part of all the calculations met with in finishing.

Next comes the other extreme, or goods where no shrinkage is given, but where the weight is regulated by flock only. These cloths are generally union cassimeres, and they usually come from the loom lighter than they are to finish. These goods, which have a cotton warp and wool substitute filling, do not lose much in the finishing; 15 per cent loss is a fair estimate, subject, of course, to variations. For example, a piece of union cassimere (narrow) comes from the loom weighing 9 ounces, and is to finish 12 ounces per yard. The loss is 15 per cent. This loss and the extra 3 ounces are to be made up by flocks. The clean weight, according to explanations given, is $9 \times .85 = 7.65$. This is subtracted from the 12 ounces, weight wanted; $12 - 7.65 = 4.35$ ounces, the amount of flocks to be fulled into the piece to make the required weight per yard when finished.

Whenever flocks are used it is found that about one-half of the flocks put on the goods will felt on sufficiently to stay, and therefore the amount required is double what the figures give. If every particle of flocks of the 4.35 ounces would felt on the fabric,

it would be an easy matter to make weight by flocks; but flocking is generally resorted to on low-grade goods, where the stock itself is not of the best felting quality. The flocks also vary considerably; therefore, the whole must be closely watched and good judgment used. In the case given, 4.35 doubled gives 8.70 ounces per yard of flocks.

Rule: Multiply gross weight per yard by clean weight decimally expressed, and subtract this from required weight and multiply by 2.

The next example is for another kind of goods. There is given a certain amount of flocks, and the rest of the weight is made by shrinkage. A piece weighs 22 ounces per yard from the loom, and is to finish 24 ounces. Four ounces of the weight are to be made up by flocks, the rest by shrinkage. As in all cases, the clean weight is first found, and to this is added the amount to be made up by flocks. The loss is 20 per cent. $22 \times .80 = 17.6$; to this add the 4 ounces to be made by flocks, making 21.6. Multiply this by 36 and divide by 24, the weight wanted. $\frac{21 \times \overset{3}{\cancel{36}}}{\underset{2}{\cancel{24}}} = 32.4$

Subtracting this from 36 gives the number of inches to be shrunk per yard to give correct weight. It must not be forgotten to double the flocks.

Rule: Find clean weight per yard and add number of ounces to be made up by flocks. Multiply this by 36 and divide by weight wanted; subtract result from 36, which gives inches to be shrunk per yard.

Another example: The goods are to shrink 3 inches per yard, and the weight made by flocks. Weight 22 ounces per yard from loom, to finish 24 ounces. The loss is 20 per cent; shrinkage, 3 inches to the yard. First find clean weight, $22 \times .80 = 17.6$, then find how much the goods will weigh if shrunk 3 inches to the yard; thus, $36 \times 17.6 \div 33 = 19.2$ ounces, = weight per yard after being shrunk. Subtract this from 24, which gives 4.8 ounces, or weight to be made by flocks; double this amount being required, or 9.6 ounces per yard.

Rule: Find clean weight and multiply by 36 less the number

of inches to be shrunk. Subtract result from weight wanted and multiply by 2, which gives the weight of flocks actually required.

In another class of cotton-warp goods the cotton is intended to be hidden. This is accomplished by stretching the pieces lengthways, which forces the filling to the face, thus covering the warp threads. On these goods, instead of shrinkage, therefore, there is stretch, and the required weight is made by flocks.

Certain goods from loom weigh 20 ounces and are to finish 20 ounces; loss is 15 per cent, and stretch 3 inches per yard. After clean weight is found, which is 17 ounces, multiply by 36 and divide by 36 plus 3 inches stretch, or 39 inches. $\frac{36 \times 17}{39} = 15.7$ ounces per yard. Subtract this from the required weight, which gives 4.3 ounces to be made up; or 8.6 ounces of flocks required per yard.

Rule: Find clean weight and multiply by 36 and divide by 36 plus the stretch per yard; subtract result from weight required and multiply by 2, which gives the amount of flocks to be used.

EXERCISES FOR PRACTICE.

Mention the different agencies causing loss in the finishing process.

Which of them is usually the heaviest?

In what ways is this loss made good?

Work out in all details the following examples:

	Wt. from Loom.	Wt. Wanted.	Per cent of Loss.		
1.	23.5 oz.	26 oz.	17½		How much shrinkage?
2.	20 "	22 "	15		" " flocks?
3.	22 "	16 "	12½		" " "
4.	8 "	11 "	14		" " "
5.	24.2 "	26 "	22½	5 oz. flocks.	" " shrinkage?
6.	20 "	20 "	20	3 " "	" " "
7.	20 "	20 "	20	3 in. shrinkage.	Give flocks.
8.	12 "	24 "	25	4 "	How much flocks?
9.	20 "	21 "	12	Stretch 2 in.	" " "
10.	16 "	16 "	10	" 3 "	" " "
11.	18 "	20 "	15	" 1 "	" " "
12.	18 "	18 "	12½	" 4 "	" " "

Flocks. The use of flocks in the finishing of woolen goods is not always a necessity, but is resorted to chiefly on cheap goods. There are instances where flocks are a necessity on the better classes of cloths, but those cases are rare. When the felting quality of the stock is of such character that sufficient shrinkage for the desired weight cannot be acquired, of course flocks must be used. Again, perhaps the nature of the weave is such as to prevent goods from shrinking sufficiently to make the proper weight, and in these cases, also, flocks are used. Consumers generally regard all flocks as a detriment to woolen goods, and they are reluctant to buy cloths containing them; but if the flocks are properly applied, and if the quality is of the right sort, there is no reason why they should be a detriment (at least, if not carried to excess). When, as in some mills, the goods are woven the year round of the same weight, and when the heavier or winter-weight goods have to be made in the finishing room, flocks are used in such quantities as to become a nuisance. Still, quite an amount of this class are yearly made and sold, which shows that there is a certain trade which demands them. On kerseys, however, even the finer grades, a good flock well felted in, is more of a help than a detriment to the fabric, for the flocks tend to fill up all crevices, and a good solid piece of cloth is the result. Then, also, on other face-goods which depend upon a close felt for the finish, flocks help in so far as they lengthen the fulling process, and this in turn gives a finer and a closer felt.

In order to perform flocking successfully, two things must be considered, as they are of the utmost importance for good work: these are, first, the quality of the flocks, and next, the manner of applying them.

The most important of these is the quality of the flocks to be used, and here the most glaring mistakes are generally made. The flocks should possess enough of the felting quality to combine well with the goods, and if this is lacking, it matters little how carefully the process of flocking is conducted, for it will not be a success.

The quality of the flocks may be inferior in point of stock, or if that is not the case, the felting qualities may have been destroyed by grinding, instead of cutting them. This subject receives

proper attention in the Appendix, and therefore need not be enlarged upon at this time; suffice it to say that the first consideration should be the proper quality of the flocks to be applied.

The next in importance is the manner of applying flocks, and upon this point there is quite a diversity of opinion. In reality it matters little what method is employed, provided the amount of flocks required is put on the goods in such a manner that it will stay. If this latter point is accomplished, the method employed is the correct one, even if it is at variance with other ideas. All cloths intended for flocking are carefully tacked, so as to protect the face. One method is to take the flocks and rub them into the back of the goods before they go into the fulling mill. Another is to put the goods in the mill and start up dry then the flocks are applied and the goods are run for about fifteen minutes, so that the flocks may be evenly distributed. The goods are then wet. Another method is to put the goods in the mill and soap them, and when they begin to get warm apply the flocks. Still another way is to apply part of the flocks dry, and the rest after the goods have run long enough to get warm.

In considering the merits of these methods it will be noticed that when flocks are applied to goods in the dry state there is nothing to prevent their getting on the face, no matter how well the goods are tacked. The fabric is dry and still open, and the flocks are absolutely certain to work through to the face. A cloth will never look as well when flocks are applied dry. Therefore, the first two methods mentioned are open to this objection; still, circumstances may be such that it is wise to adopt them. The third method is generally considered the best, for when goods get warm and commence to felt, it is reasonable to suppose that the flocks will take better. The only point which detracts from this is the necessity of putting on all the flocks in too short a time, thus retarding the fulling too much, unless that is the object in view. Flocks should be put on a little at a time after the goods become warm, and should be sprinkled evenly and lightly, thus they will be at once held to the goods. In this way it takes less flocks to make weight, for a smaller quantity will be found at the bottom of the mill.

The great objection to this method is the time and care

required. Each machine requires the whole attention of one man for the time being, which, especially in large mills, is out of the question, for it makes the labor cost of the finishing too high; therefore, flocking part dry and part wet is used when excessively large quantities of flocks are consumed, in order to reduce the cost. There is no machine which aids the fuller in this labor, and consequently methods are employed which are not always in harmony with the best finish which can be produced.

Correct Weight of Finished Fabric. When making weight by shrinkage it is always a good plan to set the goods up half an inch or so more than the actual amount required to make weight. This will allow for the stretch immediately sustained in the washer. If the amount of shrinkage is small and the goods full easily, it is a good plan to let the trap down on the goods without adding any weights. After the goods get warm, stop and examine them at stated intervals, to note the progress. If the width comes up faster than the length, it is necessary to put more weight on the trap, increasing the pressure. If, however, the goods come up faster in length than in width, take off some weight, or take the trap off for a while. This, of course, is not necessary in every set of pieces that are in the mill, but should be done when a new style or grade of cloth is started. After the first set of a style has been fulled, all others of the same style will run very nearly the same, so that it is only necessary to remember how it has been treated in order to go ahead with them.

If the memory cannot be relied upon, it is a good plan to have a notebook and put down such things.

When making weight by means of flocks, the mill is not cleaned after every set, and the flocks are allowed to gather in corners, to stay there until the general cleaning is done on Saturdays. By doing this, the amount of flocks put on will all go on the goods, and the chances are that weights made the latter part of the week, when everything has assumed its regular shape in this respect, will be evener than those of the first few days. Monday mornings, especially, it will pay to be generous with the amount of flocks applied. These remarks seem to indicate that there would be a good deal of unevenness in flocking, but it will be found that with watching and good judgment this is not so. It

is not all done by following a given recipe, for those things are of little account in finishing if followed closely. There are few hard and fast rules in finishing, as a whole, and none as regards the use of flocks. The making of weight by shrinkage and flocks combined, presents a phase of work which differs from the rest, in that if flocks are applied, as is usual, in the wet, the shrinking of the goods lengthways will be stopped too long and, as is often the case, the goods will come up in width long before they are fulled in length. Of all conditions this is the worst, for the goods will either be light in weight or narrow, neither of which is desirable. This may be overcome by giving the amount of flocks, if it is not too large, immediately after the goods are soaped; and as the flocks will absorb considerable moisture, it will be necessary to give more soap afterwards, in order to bring the moisture up to the point where it should be. If the amount of flocks is large, give one-half of it first, and just before the goods get too warm, give the other half; then, when the felting begins, the conditions will be such that with a little care the length and width will come up even.

Soap. Thus far much has been said about soaping and soap, and before considering the fulling process any further, this factor will be considered. The soaps used in woolen mills are classed under two distinct heads, viz.: soda and potash soaps. As is indicated by the name, soda soaps are so called on account of the saponifying agency employed, the fatty ingredients being saponified by means of caustic soda, while in potash soaps caustic potash is used for the same purpose. The difference, therefore, in these two kinds of soap is primarily in the saponifying agency employed in their production: thus the properties of caustic soda and caustic potash should be understood. Caustic soda is prepared from carbonate of soda by the use of caustic lime. It is less soluble in water than caustic potash, and is also less caustic. Caustic potash, or hydrate of potassium, is also produced from carbonate of potash by means of caustic lime. The causticizing action of the lime upon either consists in this, that it withdraws the carbonic-acid gas from the alkali and substitutes its own water. The action of soda soap upon the wool fiber is anything but beneficial; still, this soap is almost universally used in this

country. In Europe it is conceded by the best manufacturers that without the use of potash soap it would be well-nigh impossible to produce the finer counts of yarn. Soda has a tendency to render the wool fiber harsh and brittle, and also imparts a yellowish color, while potash softens the fiber and makes it white, as it should be. Careful examination reveals the fact that the wool on the sheep's back is naturally covered with a waxy, oily substance called grease or suint, and that this substance consists of about 50 per cent of potash combined with some fatty matter, and with practically no trace of soda. This explains why the washing of the sheep with clear water cleanses the wool to such a large extent. Potash, as stated, is easily soluble in water, and takes along enough dirt and fatty matter to make the simple washing of the sheep before shearing of great benefit to the wool. This might be regarded as a hint from Nature, but unfortunately very little heed is paid to it. There are some very strong reasons why this is disregarded:

First.— The fact that a potash soap is a soft soap and is by many regarded as inferior in value to the hard soda soaps. Manufacturers think they are paying for too much water when buying potash soaps, but in reality there is less water in a potash soap than there is in the hard soda soaps. Some of the materials used in making soda soaps have a great affinity for water, especially cocoanut oil. More water can be put into a cocoanut-oil soap than in any other and still allow the soap to remain hard.

Second.— Such things as refuse fats, tallow, etc., are not suitable for a potash soap, oil being required in its make-up. Formerly fish oils and olive oil were used, but olive oil being expensive, fish oil took its place. The objectionable smell of this ingredient, which will cling to it and impart to the goods a peculiar odor also has, no doubt, much to do with the use of soda soap. However, since the manufacture of cotton-seed oil has been brought to such perfection, this product successfully takes the place of fish oil, and a satisfactory potash soap may be obtained by its use.

Third.— That it was impossible some years ago to procure a pure caustic potash for soap making, but such is not the case now, for any amount of pure potash may be obtained in the market to-day. Formerly only wood ashes or Montreal potashes

were obtainable. These ashes contain from 3 to 6 per cent of soda and generally about 20 per cent of impurities, so that the production of a good potash soap was a difficult matter and quite expensive. A good potash soft soap made from cotton-seed oil can be produced at a lower cost than a tallow hard soda soap. Hard soda soap can be made without boiling, by what is termed the cold process. This is made possible by the use of caustic soda, which can be bought readily in large quantities.

Recipes. For fulling purposes the following process will give one of the best soaps that can be had: Take eight (8) pounds of powdered caustic soda and four (4) pounds of caustic potash, and make a lye with 20 gallons (British standard 200 pounds) of water; then melt 72 pounds of tallow, and when the lye cools to about 80° F., pour it into the tallow in a small steady stream, stirring mean whilewith a paddle until all the lye has been added; let it stand well covered for about a week, and a hard soap will be the iesult, which for effectiveness and purity cannot be equalled. For making a pure potash soap, proceed as follows: Place 50 pounds of pure caustic potash in an earthenware vessel with 5 gallons, or 50 pounds of water. Stir once or twice; it will dissolve at once and become quite hot. Let it stand until the lye thus made is nearly cold, or about 80° F. Place in a convenient vessel for mixing 20 gallons of cotton-seed oil and about 20 pounds of clean, melted tallow. Pour the lye into this mixture of oil and tallow in a small, steady stream, and stir with a flat, wooden paddle. Continue this until all the lye is run in, and until the oil and lye are thoroughly combined and is in appearance like honey. Then cover up the vessel and put it in a warm place until the next morning; the oil and lye will then be found thoroughly combined. The result will be about 300 pounds of a highly concentrated neutral potash soap, which, however, will be improved by keeping a week or two before using. The soap thus produced has not the appearance of ordinary potash soap, being slightly opaque. As far as practical use is concerned, however, it is very much better, because it contains less water than the common potash soap which is usually sold. It is as near neutral as it can be, and is intended for fine

scouring purposes and fulling. The strength of the soap for fulling, especially for fulling in the grease, may be obtained by the use of refined pearl ashes. Under no circumstance should sal soda, soda ash, crystal carbonate or alkali be used with such soap as this. As already stated, this soap is highly concentrated. For use in fulling, take about 100 pounds of it and add about 50 pounds of water. Heat gently and stir, so as to mix well. As soon as the water is taken up stop heating, and a clear homogeneous and much stiffer soap will be produced. To regulate the strength add pearl ashes to the water before heating in quantity sufficient to give the required strength. If 5 pounds of refined pearl ashes are added to the water to 100 pounds of the potash soap, as described, a good strength fulling soap is obtained. The advantage of making one's own soap does not consist alone in the point of economy, but very largely in that of efficiency, for the reason that there is an absolute certainty of having an unadulterated and uniform soap. An adulterated soap, and there are many, is not only dearer from an economical point of view than a pure soap, because it will not do as much work, but often the adulterations have a most injurious effect in the case of fulling or scouring delicate fabrics or light colors. All this may be avoided by making one's own soap. Adulterated soaps are chiefly, if not solely, found among soda soaps. One of the most common and harmless adulterations practiced in soap making is the quantity of water which can be gotten into the soap without its becoming soft. Sulphate of soda, alkaline solutions, soluble silicate, Fuller's earth and starch form some of the adulterants used. As it is quite an item in a year's soap bill to have the water reduced to its lowest possible point, the users of soap should be able to determine for themselves the amount of water contained in the soap they are using.

Soap Tests. A simple method of finding the amount of water in soap is to carefully weigh a few thin slices of it. These slices are dried at 221° F., for as long a time as there is any decrease in weight. The loss in weight is the measure of the uncombined water in the amount of soap under treatment, and from this the percentage of uncombined water is easily figured. Cocoanut oil has been mentioned as one of the materials used for making a soap

which is able to hold more uncombined water than any other, and it also serves as a good medium for the introduction of any of the other adulterants mentioned. Cotton-seed oil is another oil susceptible of adulteration, not alone to water, but also to Fuller's earth and silicate of soda. Tallow-chip soaps generally contain quite an amount of water, and often nearly as large an amount of starch.

While water may be easily estimated, the amount of starch is not as easily found. Any salts, if added to the soap, such as alkaline, silicates, sulphates, etc., may be detected by boiling a sample of the soap in alcohol. The soap will readily dissolve, but not so the adulterants. These will form a residue, which is collected in a filter, washed with hot alcohol and weighed, to find the percentage contained in the soap.

The relative merits of soda and potash soaps as regards the finishing of woolen goods is, therefore, not to be sought for in any of the qualities of these soaps, but is wholly a question of price and habit. As soda soaps, then, are the kind most used, a few words as to the manner of using these soaps in the finishing room may be of advantage. As soda soaps are now produced on such a large scale, and by so many different firms, the chances of getting a fair article are very much improved and the chief consideration is to get a soap which is uniform the year round. This is of great importance, and if a finisher has such a soap he should avoid changes. It is the height of folly to frequently change soaps when the kind in use gives satisfaction, for you already know what you have, but are by no means certain of what you are going to get.

Palm-oil soaps are generally used for fulling purposes, and on most goods this kind is superior to any other. Tallow soaps have the best body, but are so difficult to get rid of that the washing process is lengthened to quite an extent whenever they are used. They are seldom employed except when a very heavy-bodied soap for long fulling is needed. Olive-oil soaps are the finest made, and are used only on the finest grade of goods, although they would be excellent on any class; but on account of cost they are not used except on the finest grades.

Strength. When making a batch of soap for the fulling proc-

ess the length of time the goods are to run in the fulling mill must be taken into consideration, for the body of the soap should be heavy enough to last through the process and still have some vitality left at the end. If the body is not sufficient to last to the end of the operation of fulling it will turn watery, thus losing in the first place its lubricating power, and the goods will begin to chafe and wear more or less in the mill. This might not be injurious ; but if the soap is spent, all the grease and dirt which have been loosened by it during the process, and which the soap should hold in suspension until the whole can be removed in the washer, will become set again, and dirty goods will be the result. It will be found twice as hard to start the grease again, once it becomes set, as it was in the first loosening. The body of the soap, however, does not start the grease, but simply holds it in suspension after it is started ; and for the purpose of starting such grease the strength of the soap, produced by alkalies, is relied upon. A fulling soap, then, must have body enough to last through the process, and strength enough to properly start the grease. Two ounces of hard palm-oil soap to each gallon of soft soap to be made will give body enough to the soap to last from 1 to $1\frac{1}{2}$ hours fulling; $1\frac{1}{4}$ ounces of tallow soap would be required to reach the same result, or 3 ounces of cotton-seed-oil soap, although this latter is used very little for fulling purposes.

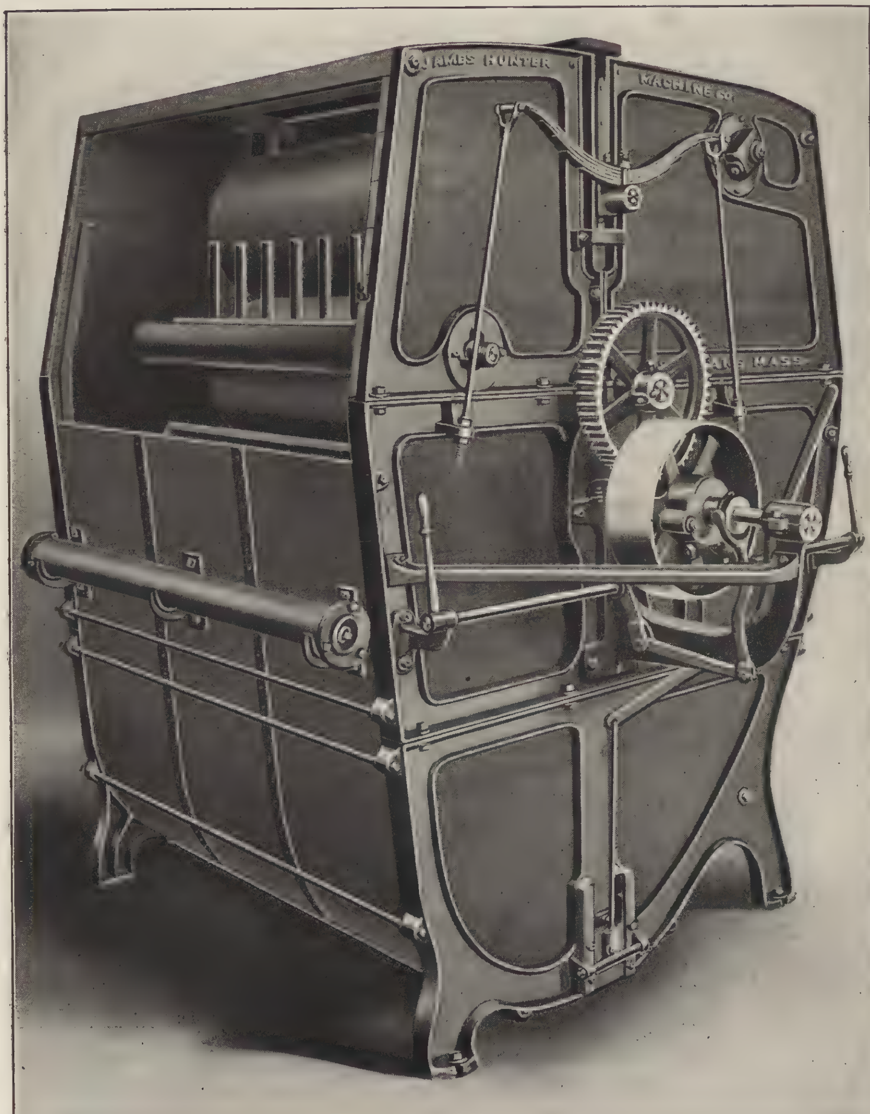
The strength of the soap is not alone regulated by the requirements of starting the grease, but as it is a powerful aid to felting, it is also used to regulate the time required for fulling. For instance, if goods do not full as fast with a medium-strength soap as they should, an increase in strength will surely shorten the time required for fulling. Still this must be carefully considered, for it is just as easy to overdo the matter of strength as it is to fall short.

Pure ammoniated alkali is best to use for making fulling soft soap, and 3 ounces of this to the gallon will be found to give all the strength commonly required of soap. The capacity of the tank in which the soap is to be made must be definitely known, to be sure how much soap and alkali to put in. It is best not to trust to hearsay upon this point; and the finisher coming into a new place will create a vastly better impression if he quietly

measures his tank and then tells his employees how much of each article he wishes to have used, than if he tries to find out by asking how many gallons each tank holds. The rule for finding the capacity is simple enough, and should be known by all to whom it would be of advantage. Square the diameter in inches, *i. e.*, multiply it by itself, then by .7854, and also by the height, and divide by 231, the number of cubic inches in a standard liquid gallon.

Another rule, a little shorter, which gives an approximately correct result is: Square the diameter, multiply by the depth in inches, and also by .0034, and the result will be the gallon capacity of the tank. The fractional parts of a gallon do not play an important part in these calculations; in fact, when the contents of a tank are found, it is customary to call it three or four gallons less, for the tank is never filled to its utmost, because that would prevent stirring, and also few tanks are set level enough to make it possible to fill them completely.

Application. When the capacity of the tank has been determined, let it be filled $\frac{1}{4}$ full with water and turn on the steam. Then the soap is made ready and carefully weighed, in order to insure uniformity of the different batches. The soap should be cut into small pieces, and large chunks should not be allowed to go into the tank, for it is not only important to use the proper quantity of soap, but the soap should be put in in such a manner as to readily dissolve. When the soap is ready, place it in the tank and bring to a boil, after which the steam is turned partly off so as to keep it boiling moderately. Then weigh off the alkali, and when the soap shows signs of getting soft add the alkali to it and let the whole boil easily for five hours. This is ample time to insure a thorough combination of soap, alkali and water. After boiling the stated time the water is turned on and the tank filled up, keeping the steam on at a good head during the filling up, and frequently stirring with a paddle. When the tank is filled turn off the steam and let the whole get cold. This will take probable a day or two. It will then be found that a fine-grained, well combined soft soap is the result. Always wait until the soap is cold before using it, for nothing is likely to produce worse results than warm soap put on the goods in the fulling mill. The goods



LEFT HAND SIDE OF STANDARD SIX-STRING CLOTH WASHER
The James Hunter Machine Co.

are sure to be uneven, and on fancy goods clouds and blotches will frequently show themselves. The soap must be well stirred and broken up before putting it on the goods, or else it will leave the pail in large chunks, which cause much spattering and have a tendency to leave dry places. These places would eventually become moistened, and the fuller being aware of the fact should wait somewhat longer before he examines the goods to see if they are wet enough; but if he should not wait, and when examining the goods should happen to find just such dry places, he would at once put on more soap and find later that the goods then have too much. Therefore, have the soap well broken up, so that it may be poured from the pail in a steady small stream, and no evil results will be met with.

It was stated before that the advantages of making one's own soap are of great importance, but in some cases this may not be true. The making of one's own soap by the use of saponified red oil is one of these cases, and merits attention here. It is argued that as red oil is chiefly used on the stock when prepared for carding, a soap prepared from the same material will more readily assimilate and thus make it easier to remove such oil from the goods. This line of reasoning has every appearance of truth, but in actual practice it is quite different. It is an established fact that perfect saponification cannot be obtained with the use of simple alkali, no matter how long or how hard the stuff is boiled; it takes a causticized alkali for perfect saponification, and such will take place whether heat is employed or not. What can be gotten from red oil and alkali by boiling is simply a combination of water, oil and alkali resembling soap, but which will ultimately separate again if left standing long enough. Furthermore, a part of the alkali used in making this red-oil soap goes to combine the oil and water into a semblance of soap; but how much of the alkali is taken up in this way is an unknown quantity and varies with conditions over which the maker has practically no control, and therefore causes an unevenness in the mixture which is not at all to be desired.

Red-oil soap also lacks the softening qualities which are so necessary in the finishing of woolen goods. It is a curious fact that the goods which need the softening qualities of a good soap

more than any others are usually those which are treated with this kind of soap. Low grade goods are about the only ones on which it is used, for the manufacturer of the better class of goods does not care to use this quality.

Cost. In point of cost it may be well to compare red-oil soap with a good No. 1 palm-oil soap. One gallon of saponified red oil will make about 30 gallons of soap of a consistency to last for about $1\frac{1}{2}$ hours fulling. The cost of the oil alone would be about 45 cents per gallon, making about $1\frac{1}{2}$ cents for the gallon of soap. This is simply the cost of the oil, leaving the alkali and the long boiling out of the question. No. 1 palm-oil soap can be bought for about $5\frac{1}{2}$ cents per pound; and 2 ounces of this, with less alkali and the less boiling, will give a soap which will last as long and be twice as valuable to the finisher. The cost is $\frac{11}{16}$ of a cent, and shows, therefore, less than half the cost of the inferior grade.

Usually one of the first considerations is the cost of an article; though for the best results this question should receive no consideration except when articles of equal merit are at issue, but in the case of red-oil soap even this is reversed.

Roping. Having carefully considered how soap should be prepared for fulling, and before taking up the next process, a few words as to the troubles met with in fulling may be of advantage. One of the most frequent difficulties the fuller has to contend with is the rolling and roping of the goods in the mill. This is due chiefly to the construction of the cloth, and probably cannot be avoided on some styles. Whenever this trouble shows itself the mill should be stopped at once and the goods taken out and well shaken, so that they will open out in good shape; afterwards run them into the mill again, but this time take the other end first, so as to have the cloth run wrong end first, and in the opposite way from which it was started. When in the mill with the ends sewn together start up and give a little fresh soap, just enough to give a little extra lubrication. Be sure that the goods do not become too wet. Usually it will be found that they will run properly, but if they still persist in roping, this will have to be repeated, in order to have them finish all right.

It is impossible to shrink goods properly when they are in a solid rope, and uneven fulling is sure to result. The shaking out

of the goods is as important as the turning end for end, and should not be neglected, but very thoroughly performed.

Choking. When first starting the mill, pieces will often choke up behind the trap, forming into a very hard lump. This is chiefly found on heavy-weight goods and solid weaves, where the pieces are of a somewhat firm and stiff nature. Such goods will shoot straight through the trap, and if the back cover is open will run over the back of the mill to the floor; but when the cover is down the goods will accumulate back of the trap and get into a hard lump there. To prevent this let down the trap about half-way; this will stop the goods from shooting out behind, and they will accumulate in the trap-box. When this is full they will be crowded out and fall to the bottom of the mill.

When the goods are run double or treble they will often catch up and form in hard knots, thus stopping the mill. This can be prevented by measuring the cut properly before it is put in the mill. Thus if a 40-yard piece is to run double, measure 20 yards and tie a string around the piece at this place; then run the piece into the mill until this string comes up; put the first end into the center of the piece at the string and tie it again; run it till the end comes; then pull out the first end, sew the two together and the goods will run smoothly. When goods are wanted to run treble, measure off one-third the length of the piece, and proceed as before, and there will be no trouble. A new hand hardly ever has trouble of this kind, for he will measure the piece as directed; but the old hands get so used to it and so expert that they can run half a piece without much trouble. Every now and then, however, they will find that they have miscalculated, and that the mill is choked up.

Stop-motion. Most mills are provided with a stop-motion which is connected with the front guide-plank. This works on a rod, and as soon as a knot forms which cannot readily run through the guide-rings, it will lift this guide-plank, and an arm being attached outside the mill will knock off the shipper and let the belt travel to the loose pulley. If the stop-motions would always work there would be no loss except that of time; but it often happens that they work imperfectly and do not throw the shipper off enough to stop the mill. The rolls will then turn and the

cloth remaining stationary will soon wear through and get hot enough to burn. So not only should the goods be put in carefully, but the stop-motion should be well taken care of, thus making sure that it works properly at all times.

Seams. Very often there is a terrible crash at stated intervals

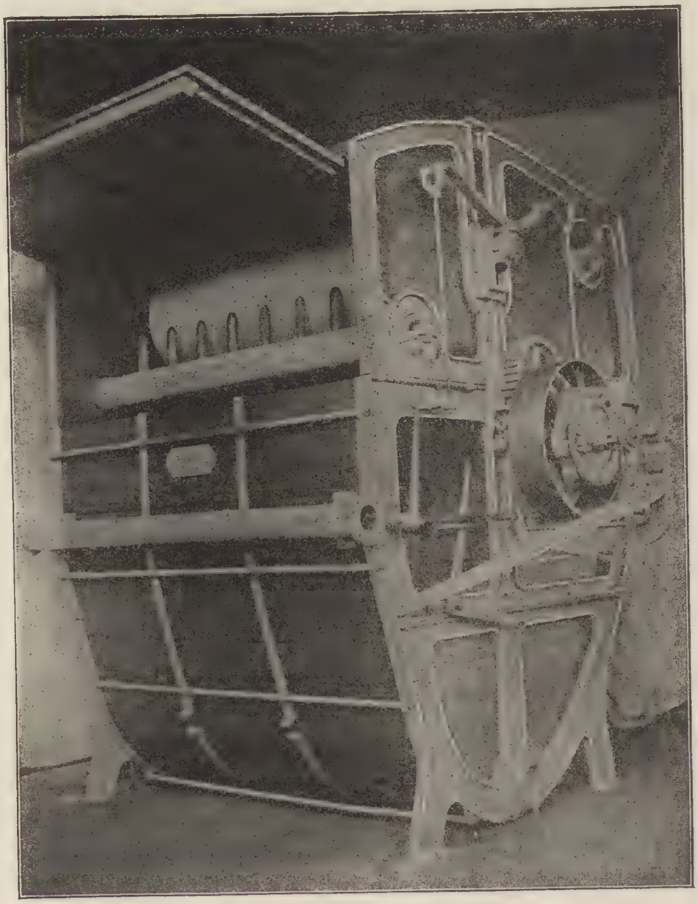


Fig. 5. Washing Machine.

in the mill, as if some one had hit it a heavy blow with a sledge hammer. When this is heard after the goods have been soaped, it indicates that the seam has not been properly made, and it is best to stop and examine. It will be found that the seam has

either been made too deep, causing a bunch, or else has been made so that it will not turn inside, presenting a smooth side to the roll. Every time this bunch goes through the rolls it causes a heavy knock, which is not only harmful to the mill, but is also hard on the seam, and has a tendency to wear it to such an extent that it often parts, and the goods are found in the bottom of the mill instead of running. It is much easier to make a good seam when the goods are dry than after they are soaped, and therefore look carefully after the making of the seam, and have it so that it will be firm, and still not cause much of a bunch.

These few precautions carefully remembered and practiced, together with a painstaking disposition, will go far towards making fulling a success.

WASHING.

Handling of Goods. The next branch of the wet-finishing process is the washing of the goods. This part of the work is of great importance, especially when it is considered that upon the cleanliness of the goods depends in a large measure the future success of the finishing process. The great trouble with goods which are not properly cleaned, is that this evil is not always noticeable at the mill, especially if the pieces are very nearly clean. Such goods will pass at the mill as being clean, there being no noticeable smell or anything of that kind about them ; and if they were immediately consumed, that is, if they are at once cut up and made into garments, there would in all probability be very little, if any, trouble. But this is not always the case; sometimes the goods will remain in the case for quite a length of time, and in such instances, if there is the least trace of grease left in them, it will be unpleasantly manifest when the case is opened. The cloth will naturally be rejected without any further examination. Perhaps this may really be due to only one or two pieces in the whole case; but as the rest have come in contact with those pieces, and have been exposed to the influence of the greasy smell, they have suffered more or less by such contact, and it is just as well to have them rejected, also. If goods were always taken out of the case and stored where fresh air had free access to them, in many instances there would be no bad results from a trifling uncleanliness, but as the finisher cannot rely upon any such procedure, he

must watch the only place where he can form a definite idea as to their cleanliness, and this place is the washer.

Construction. Fig. 5 represents a machine of this kind. As will be seen, it consists of two heavy rolls, usually made of rock maple, and of one piece. These rolls serve to draw the cloth through the water and act as squeeze rolls at the same time. The top roll will also have elliptical springs attached to it, to increase the pressure. In front is shown the water pipe, which has as many outlets as there are pieces intended to be run in the machine, so that the stream of water from each outlet will act directly on the pieces. These machines are built in several sizes to suit the necessities of the different mills, and are made to run four, six or eight pieces at a time.

Fig. 6 represents the section of the washer rolls. These also vary in many machines, but eighteen inches is a fair average. They are made of a solid rock maple. The guide rings, A A, are about six inches in diameter, and are usually made of porcelain. They are set in planks, as many as there are pieces to be run in the washer. The solid roll, B, is about six or eight inches in diameter, and also varies, but as long as the top of the roll is on a level with the top of lower washer roll, the diameter matters little. The roll, D, is set a little above the center of the top-washer roll and is sometimes solid with lags, and often in the shape of a spider with lags. Immediately below the bottom roll is found the suds-box, E. This box has as many apertures as there are pieces to be run in the washer. The suds squeezed out of the goods by the rolls gather in this box, and through the apertures fall again on the pieces to be used over again until they are thoroughly impregnated with the impurities which they are intended to remove. When this time arrives the apertures in the bottom of the box may be closed, and at the same time a gate at the side opened to let the dirty suds pass out from the washer. This enables very much quicker washing, for the soap which is squeezed out by the rolls does not fall back into the washer, but passes off outside. The guides, as will be noted, on the top bar in front of the rolls are wooden pins. Inside of the washer, right above where the water enters, is another guide-plank, which serves to keep the pieces separated, and prevents their tangling.

In most mills the washing falls under the immediate supervision of the fuller, and if he happens to be the right sort of a man, much will be lifted from the shoulders of the overseer; but unfortunately the washing as well as the fulling is too often entrusted to cheap and incompetent hands, so that the finisher must be constantly on the alert. Even if the men to whom the washing is entrusted are competent, the finisher should watch the washing process very carefully.

There is no positive assurance that the goods will be clean unless the lather is thick and creamy, and even after the first lather, which removes the heavier dirt, has been drawn off and becomes whiter, it still should be thick and creamy. There are

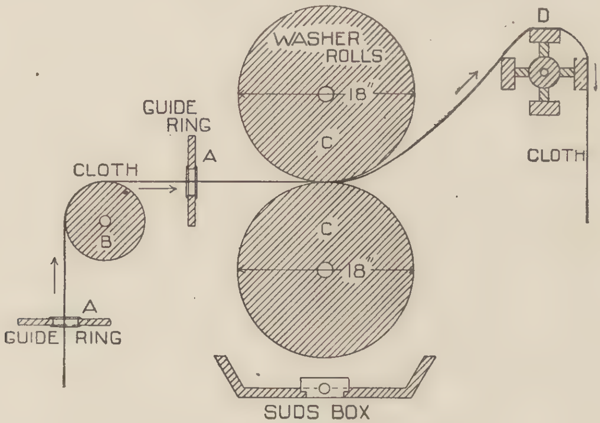


Fig. 6. Cross-section of Washer.

several ways to reach this result, but no matter what way is used, make sure that the lather is of the right kind, or poor work will result sooner or later. The advocates of a scouring liquor to be used in the water, in addition to the soap already in the goods from the fulling process, run more chances of failing to have clean goods than those who depend upon the soap in the piece (from the fulling mill) to produce the lather required to ensure clean goods. If the finisher who adopts this latter method sees the goods lather up in the washer properly, he may be absolutely sure that the pieces are clean. Fresh soap added to the goods in the washer will produce a good rich lather, but if the fulling soap has become spent in the

process, and the dirt and grease have become set, it will take more than a common washing to start them again to be able to remove them. Under these circumstances it is difficult to learn that this has taken place. The finisher simply washes the goods in the usual way, and finds later on that the goods are not clean, and is lucky if this fact is not detected before the goods leave the mill.

Operation. The pieces are put in the washer at the back, each piece being thrown in, keeping both ends out. Then one end is passed under the suds-box and through the guide rings and pins and put in the roll. The machine is now started to let the end through far enough to enable the two ends being sewn together. Do not omit to pass the end over the roll which is found at the back of the large top washer roll before sewing the ends together, for if this is omitted, the pieces will stick to the large roll and go around with it, causing much work to extricate them again. This small roll is of vital importance, for without it the pieces would cling to the roll instead of going to the bottom of the washer.

The pieces being sewn together form an endless string, from which fact the several machines are named either 4, 6, or 8-string washers. When all the pieces are put in, start up the machine and see that everything runs smoothly. Close all the gates, turn on the water, and fill the washer half full of warm water of no higher temperature than 110° F. Let the goods run in this for about twenty minutes, at the end of which time a rich and thick lather, though dirty, should fill the washer. If it does not appear, but is thin and watery, it is clear that the soap from the fulling has been spent, and a more thorough washing must be given, as will be explained later. At the end of twenty minutes, if everything is as it should be, open the gates and draw off the dirty suds, and then shut the gates again and fill the washer half full of warm water, and run about fifteen minutes. After a few minutes running the lather in the washer will begin to rise. This time it will be much whiter, but still, in about ten minutes will become almost as thick as before. Now open the gates and draw off this suds; when washer is half empty, open the valves of warm water and rinse as long as the supply will allow, but try at any

rate to rinse about twenty minutes with warm water. Then gradually open the cold water valves, and when open, close those which admit the warm water. Rinse about forty-five or fifty minutes in cold water, then take the pieces out, and they will be as clean as can be desired.

This will be found to be as satisfactory as any method which can be adopted, but unfortunately the question of warm water is often a difficult one. It is not infrequent that no provisions are made by the management for this very important function; and if such is the case, the finisher will have to heat the water in barrels and apply it with pails. This of course precludes the possibility of twenty-five minutes' rinsing in warm water. On account of such drawbacks it is often advisable to dispense with the use of warm water altogether. The washing can, of course, be done with cold water, but it is not as good for the pieces. When they are washed entirely in cold water they will not feel quite as soft as they will when plenty of warm water is used.

If the supply of warm water is inadequate, the process had better be performed entirely with cold. For this purpose turn on the water and fill the washer half full, and run thirty minutes, then draw off, and repeat the same, after which rinse one hour. If, as stated before, goods fail to lather well, draw off the suds at once, and give each piece two or three pails of scouring liquor; then let them run twenty-five minutes and repeat this. After the second drawing off, fill the washer half full of warm water and add about a quart of aqua ammonia to each piece, and let them run in this twenty minutes. Draw off and rinse with warm water followed by cold water for one hour. This will no doubt clean the goods.

It will thus be seen that a good rich lather is not to be relied upon when the same is produced by fresh soap, but if it is gotten without fresh soap, but from the goods as they come from the mill, with nothing but water, it is a sure sign that satisfactory results will be obtained.

Under no circumstances stint the rinsing time, but let it be thorough, no matter how long it takes. The condition of the water has of course much to do with it, for the softer and purer it is, the better it will rinse out the soap; but hard water contain-

ing much lime will always be found troublesome unless some means can be employed to soften it. While a trace of soap remaining in the goods is not positively detrimental to cheviots, cassimeres and the like, it becomes quite a factor where goods are face finished or piece dyed. Any trace of soap left in the pieces will make it nearly impossible to produce the desired finish, and if the goods are subjected to the steaming process, the bad effects of soap remaining in them will show plainly. Most of the cloudiness sometimes found in steam-finished cloths is directly traceable to this cause.

The requirements to produce a clean cloth having been established, it is again in order to state how these things can be produced without fail. To start the grease it has been shown that alkali is required, but after this has accomplished its mission, and has started the grease properly, the body of the soap used in the fulling must be relied upon to hold this matter in suspension until it can, by the action of the water whether warm or cold, be removed in the washer. Therefore, at the end of the fulling process, examine each piece by twisting, to see if there is any vitality left to the soap. If there is, it will soon show by twisting the goods in your hand, and leave no doubt as to whether it is soap or a thin watery substance without any resemblance to soap. Make sure of this before starting the goods in the washer. On fine goods which require a close felt for the finish, such as the finest doeskins and broadcloths, it is often necessary to scour the goods before fulling, to enable the fulling process to be extended, by using a soap which contains little alkali, just barely enough to give a good homogeneous soap, which, without the addition of alkali, it is next to impossible to produce.

The term "a perfectly neutral fulling soap" is often used, but in point of fact such a thing in a soft-soap cannot be produced. The alkali can be reduced to almost nothing, but without it the hard soap and water will not thoroughly combine, no matter how much it is boiled.

When scouring "flannels," as the pieces are called before fulling, put the pieces in the washer and sew the ends together, as stated before, then turn on the water (cold), leaving the gates open, and thoroughly wet the pieces. Shut off the water, and let

the pieces drain by running a while with the gates open. Then shut the gates, give each piece three pails of scouring liquor, and let them run thirty minutes; then draw off and repeat this, giving about twenty minutes this time. Draw off half of the second amount of scouring liquor, replace with warm water, and let run twenty minutes more, then rinse in cold water for forty or forty-five minutes.

Worsted Goods, especially fancies, are often nearly scoured in the washer when being finished. They are made in the loom, and do not need fulling in the sense of the term, but if worsteds are run in the fulling mill and soaped there for about twenty minutes, the washing process will be much more easy and sure. If this plan is adopted, the same method of washing may be employed. The soap used in fulling, and which applied to worsteds is of better body than a mere scouring liquor, has a softening tendency which is much to be desired. However, if it is thought best to use a scouring liquor for worsteds, one of the best is to take about $\frac{1}{4}$ pound of pearlash to one gallon of water. This does not need to be heated. When it is used in the washer give two pails to a piece, adding about $\frac{1}{4}$ pail of fulling soap to a piece. Let the pieces run in this for half an hour, and then draw off part of the solution; replace with warm water, and let run for twenty minutes; then rinse with warm water, followed by cold water, for one hour, and the goods will be clean. It must, however, be remembered in all these operations that they admit of innumerable changes, and are not given as rules which are warranted for all cases. Circumstances alter cases in this as well as many other processes.

Scouring Liquor. A good scouring liquor can be made for use on woolen goods as follows: Take 1 ounce of a good grade of soap, or $1\frac{1}{2}$ ounces of cottonseed oil soap, and 3 ounces of alkali (pure) to the gallon of water, and boil until all is dissolved. Just before the above solution gets cold add $\frac{1}{2}$ ounce of sal ammoniac to the gallon; if added while liquor is hot this would lose too much of its value. When cold stir well from the bottom. and use as stated. This liquor can be relied upon for all kinds of woolen goods, but should not be used on fine worsteds.

For worsteds make a liquor as follows: Take 2 ounces of olive-oil soap and 3 or 4 ounces of alkali to the gallon of water.

If the alkali is considered too harsh, take 6 ounces of sal soda to the gallon. Dissolve by boiling, and add sal ammoniac, as stated before. Of all liquors for worsteds, those made from pearlash will be found to be the best.

SPECK DYE.

On very nearly all classes of goods which are not colored in the piece, and even on many of those that are, burr or speck dyeing is of decided advantage. Wool and yarn-dyed cloths ought by all means to be subjected to this process. The advantage derived from speck dyeing may be readily seen. If two pieces of the same style are finished, one with speck dyeing and the other without, and then compared, the one which has not received the speck dye will be found to require quite a large amount of labor in the way of removing specks, which on the other is reduced to very small proportions. In most cases this extra labor of removing specks is done by hand, by means of the burling or specking irons. The surface of the goods will never look as smooth after leaving the specking table as they did when they went there, and often it becomes necessary to return the goods to the shear to make them at all presentable. Some of this is no doubt due to the carelessness of the operator, but often the best of operators pull up fibers which ought not to be disturbed. This may be due either to the dullness of the irons used, or to the enormous amount of specks to be removed.

It is not to be supposed that burr dyeing will do away with any and all trouble caused by burrs and specks, but it will materially lessen such defects, and in many cases do away with them entirely. Aside from this, a piece which has been properly burr dyed always has a fuller and better appearance than those which have not been treated; and while it would be hard to point out just why the one looks so much better than the other, the fact still remains that there is a decided improvement in the looks of the burr-dyed piece over the other.

The value of burr or speck dyeing being thus easily apparent, it remains to determine how the process may be conducted so as to give the best results as to uniformity and effectiveness. It is to be remembered that burr dye, as its name indicates, is of use

only in the coloring or covering of vegetable matter, so that a wool speck still must be removed by hand. If the wool speck would be affected by the dye, of course the color of the whole piece would be changed.

Ingredients. The composition of the dye is of the first and utmost importance. The several ingredients and the rotation of adding them makes a great difference in the value and usefulness of the dye. In order to be sure that the dye has been properly prepared, take a piece of glass (a broken window-pane, for instance,) and dip it into the dye, and then hold it against the light. If the color is a rich claret, bright and clear, there is no doubt but that all the ingredients have been properly combined or boiled together. If, on the other hand, the color is a dirty black, verging on an equally dirty blue, lacking brightness and clearness, it is just as evident that the essential requirements for making a good speck dye have not been complied with. Uniformity in the making of the dye is of the greatest importance; for if one batch is boiled three hours and another only two, it is not to be supposed that the results are going to be alike.

The ingredients entering into the making of the dye are, first the coloring matter, or extract of logwood; next an acid, blue vitriol; and last an alkali, soda ash. In using the coloring matter it is best for this purpose to use an extract of logwood, which is for wool-dyeing purposes considered of inferior quality, but which for the purpose of making speck dye is better than the finer and highly oxidized grades. This is also true with the alkali. The crude product, soda ash, is much to be preferred to any of the more purified kinds. In fact, it is next to impossible to make a good dye with sal soda, pure alkali, or crystal carbonate of soda. These apparently lose in the purifying process something which is necessary for a good dye. This is also true of the finer strains of logwood. Why there should be a difference is immaterial, but the fact remains that the best results are obtained with the inferior qualities. Liquid extract of logwood or its substitute, liquid extract of hemlock or hematine, make good speck dyes. The proportions are as follows: 2 parts of vitriol, 3 parts of soda ash, and 4 parts of logwood. The acid and alkali are directly opposed to each other in their action; but if the soda ash is combined with

the coloring matter before the vitriol is added, the brightness and effectiveness of the coloring matter is nearly destroyed. This accounts for the ill success of many attempts at making speck dyeing with the same material with which another person will produce the very best dye possible. To obtain a dye which can be relied upon, it is of the first importance that the several ingredients be combined in such a manner as to retain the full force of all the coloring matter, upon which the coloring of the speck is dependent. This, as shown, is best done by first combining the logwood, or hematine, and blue vitriol by thoroughly boiling them for an hour, after all the vitriol is dissolved. Then the soda ash may be added, and when this has ceased to ferment, the whole should be boiled for three hours, and the result will be a dye which can be relied upon at all times, not alone to cover the speck in good shape, but also to give the goods the same shade, provided the same amount and strength is used.

While there should be no shades traceable directly to the dye, it must not be forgotten that on low-grade goods the stock often contains considerable cotton; and as this will attract as much of the dye as the vegetable specks it is intended to cover, the result will be that the shade of the goods is somewhat darkened; but this is rather a benefit than otherwise, as it will give the cloth a fuller appearance. As long as the amount of dye put on the goods and the strength of the same is alike, the shades will come alike. The larger the amount of speck dye made at one time the better; and in order to give an idea how to proceed, the following directions are given:

Recipe. For 200 gallons of speck dye take 200 pounds liquid extract of logwood, and add to this 100 pounds of blue vitriol. Put enough water with this to fill tank about $\frac{1}{8}$ full, and turn on the steam and bring to a boil. Then turn some of the steam off to reduce the boiling, and keep boiling till all of the vitriol is dissolved, and then continue for one hour. Turn off the steam and let the whole stand for about an hour; also add some cold water to cool it off somewhat, but not too much, for when the soda ash is added, that needs room for fermentation. Now take 150 pounds of soda ash, and add it to the solution in the tank. To do this, proceed carefully, and put in

only a little at a time, sliding it down easily on the side of the tank. When all has been added, let it lie for quite a while and ferment.

It is best to commence to boil speck dye in the afternoon, so as to get the soda ash all in, and then let it stand till morning. Commence to stir the soda ash gently, and note how it rises; if it comes up too fast, wait a little while longer. If it threatens to run over, add a little cold water, and it will slowly settle back. Avoid running over, for as soon as this happens, the best of the coloring matter will be wasted. When the dye can be stirred without threatening to run over, turn on the steam and bring to a boil gently, and as soon as it boils all danger is over, and it may be left to boil for three hours, and then the tank is filled up. The dye thus produced will stand at about 15° to 18° Baumé. This is reduced by the addition of water to the strength required for the goods.

Application. When goods are to be speck dyed, they are put into the washer and sewn together in the same manner as for washing, and then the cold water is turned on, and the goods are thoroughly wetted. Let them run for a few minutes, and then shut off the water, leaving the gates open, and let the pieces run until they are thoroughly drained, when all the gates are securely closed to guard against leakage, and the speck dye is poured on the goods while in motion. Never put on the dye with the pieces standing still, for this may produce cloudy goods. The dye will take as soon as it comes in contact with the vegetable matter in the cloth; and if the goods are stationary, the best strength of the dye will be absorbed by that part on which the dye falls and remains for a while, but if the goods are moving, this is not the case, and the dye soon distributes itself all over them. Have the dye ready in small pails or tubs, so that it can be poured on the goods as quickly as possible.

It is poor economy not to provide sufficient pails or tubs for this purpose; for if the washer tender has only one or two pails in which to prepare and fetch the dye, the results are also likely to be uneven. Each piece requires about two pailfuls of dye, and a strength sufficient to cover the speck, which in most cases can be well done if the dye is 5° in strength. The dye, as

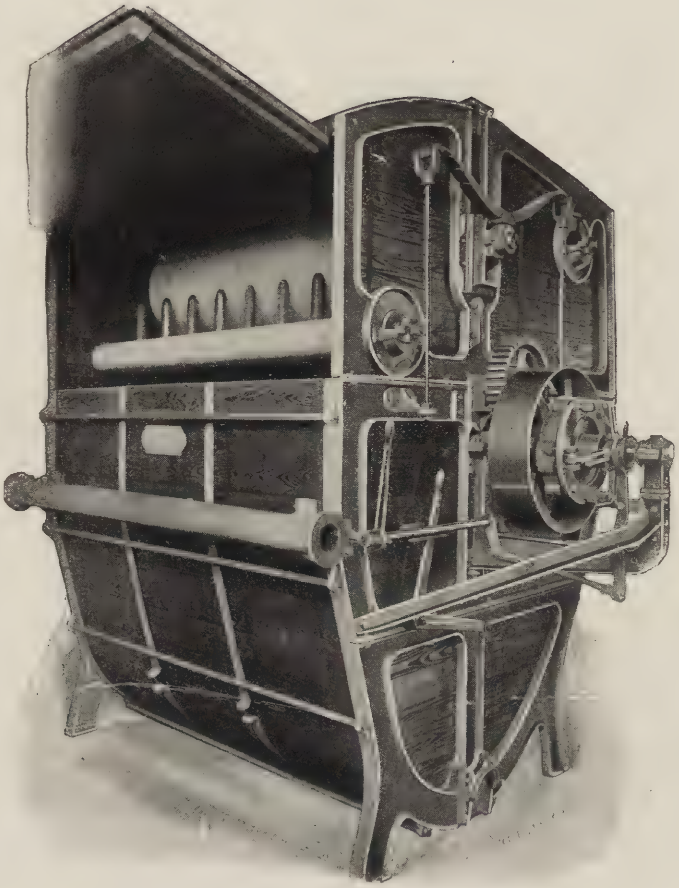
indicated before, is made about 15° or 18°, and this is chiefly done for the purpose of avoiding the frequent making of the dye, and also to have the dye cold when used, for the addition of cold water in reducing its strength to the required point will give this result. The least warmth in either dye or goods will affect the color of the wool, thus practically spoiling the goods. After the dye has been applied the pieces should run about twenty minutes, to make sure that the speck has taken all it will hold; then open the gates, turn on the cold water, rinse for about twenty-five minutes, and take out.

Low-grade Goods. It often happens on very low-grade goods, as for instance satinets, that in order to save time the speck dyeing is done in the fulling mill. While this manner of doing the work is not at all satisfactory on any other class of goods, it may be employed with some success on satinets, and perhaps on some other very low-grade goods. It is not always that the best interest of the goods under treatment is considered, for on the lower grades very often time is of more consequence than any other thing; and when this is the case, most generally speck dyeing in the mill is resorted to.

In places of this kind the appointment and means in the finishing room are generally very crude, and it is well to know how to go to work in such instances. In many cases the dye is made in a barrel, and should be very strong and of good coloring quality.

Recipe. For a barrel of 50 gallons take 75 pounds liquid extract of logwood, or hematine, and 10 pounds of blue vitriol; dissolve with sufficient water to fill barrel $\frac{1}{4}$ full; when all is dissolved add 50 pounds of soda ash, observing the directions previously given. When done this will give about 24 degrees strength, and will answer admirably for the purpose it is intended.

Application. Take 2 quarts of this dye and pour it slowly on the goods when they have begun to shrink, being sure that the pieces are somewhat dry at this stage. At any rate do not add the dye until convinced that the grease has become pretty well loosened, and that after the dye has been added the goods are not too wet. This is all that can with profit be said of this process; the danger is always present that the goods will be cloudy, by reason of their getting warm in the fulling mill.



IMPROVED ROTARY CLOTH WASHER
Rodney Hunt Machine Co.

Speck dye made after the manner given will not affect wool as long as it and the goods remain cold; but when heat is a factor in connection with it there is no telling what the result will be.

Fuller's Earth. On all fine goods, whether they are speck dyed or not, it is of great benefit to use fuller's earth after washing and also after speck dyeing. This has a tendency to purify the pieces of any remaining trace of soap, and it also imparts a soft feeling which it is impossible to obtain in any other way. In order to get the best results it is necessary to have a well-refined earth, free from impurities; with it the result will be beneficial if the matter is not overdone, in which case the result will be the reverse. To 50 gallons, 2 pailfuls of the earth is ample, and it will be found that the water will not hold more in solution without continual stirring. There will be a sediment with even this amount of earth, but not enough to do harm. When earth is used let it be put on the goods after they are thoroughly rinsed and drained, so that all the surplus water is out of them, then shut all the gates and give each piece two pailfuls of solution, as stated above. This should be well stirred before using, so as to get all the earth well mixed; then apply and let the pieces run for 15 minutes and rinse 10 minutes, after which the goods may be taken out and passed to the next process.

On face goods the bath of fuller's earth should not be omitted, both at the first washing and after speck dyeing. If such goods are intended for piece dyeing give them a bath of earth before sending them to the dye-house and after they are gigged, and the results will be astonishing. As the use of fuller's earth is not universal, it will be in some instances hard to convince parties of the benefit derived from its use, but invariably a continued use of it will show this to be a fact.

Crocking. It sometimes happens on low-grade goods that after they are all finished they will smut, or crock; that is, if the goods are handled the hands will become soiled, and consequently any lighter shade goods will be dirtied by coming in contact with them. This is often due to an imperfect making of the speck dye, and will not result if directions as to the making are carefully observed. In other cases it is due to an imperfectly colored stock, and then shows itself unpleasantly if the goods are of a fancy

nature as to colors, by having the lighter colors dulled and the whole piece assume a dull and dirty look. If this is the case, it may be overcome by giving the goods a salt bath after they are washed and before taking them from the washer. Generally goods having a percentage of colored carded cotton in their make-up are affected in this way.

Make a brine such as is used for dyeing purposes generally, about 50 or 75 pounds of coarse salt to 50 gallons of water; dissolve well, and give each piece $1\frac{1}{2}$ or 2 pailfuls after shutting all the gates; let them run in this for 10 or 15 minutes and then take them out. Do not rinse the pieces.

SINGEING.

The *Singeing* Process, while not in actual rotation following the preceding processes, is in some instances employed on goods in the wet state, though it usually takes place directly after the goods are burled and mended. This process is simple in its operation, and is used to remove all fibers from the face of the cloth. It is therefore of use only on such classes of goods as are made in the loom and do not need felting or shrinking. This includes worsteds for men's wear, except worsted cheviots, and all kinds of clear finished worsted dress goods for ladies' wear. There are two kinds of singeing practiced; one is the gas singeing and the other the plate singeing. The former is used on fabrics which are of a more open nature, such as clays and serges, while the latter is used chiefly on whipcords and poplins.

When gas is used for singeing, it is combined with air so as to give a perfect combustion and a clear blue flame. The pressure of the air also forces the flame into every crevice of the goods, and removes all loose fibers completely.

On the plate singeing hollow copper plates or retorts are used, which are heated to a red heat by means of gas or oil, and are kept at uniform heat during the process. Gas singeing is the more economical of the two processes, inasmuch as the single turning on of the gas and air and their lighting is all that is necessary to start, but on plate singeing it is quite a while before the plates become hot enough to go ahead. Then, also, as soon as the pieces are run the gas and air is turned off, and there is no further ex-

pense on this score, while on plate singeing the flame has to be kept up so as to be ready for the next batch. Therefore it is seldom that plate singeing is used in any but the larger establishments.

Gas Singeing. The machines for gas singeing are now built upon a much different principle than they were some years ago, and are no doubt designed to do more work in a given time; but after all, the old style is still the best for all practical purposes.

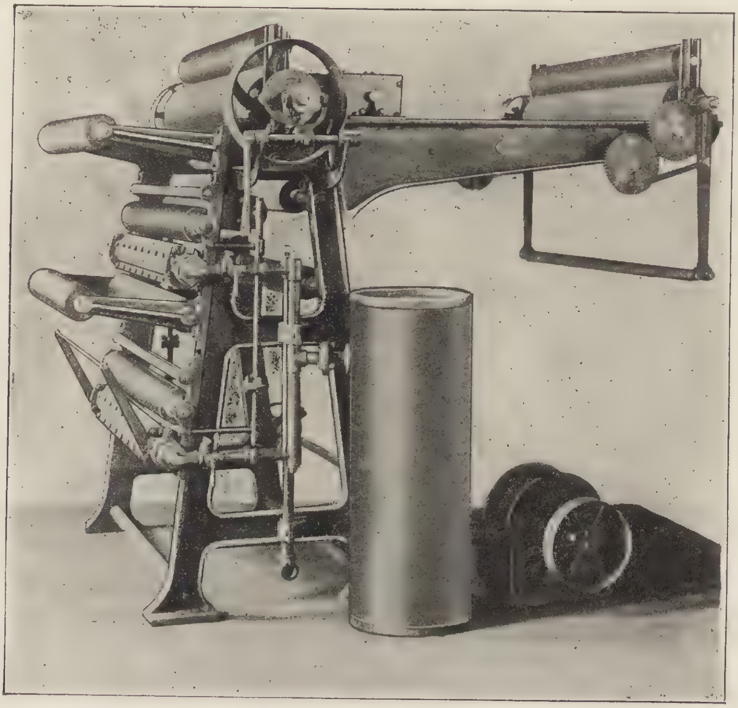


Fig. 7. Singeing Machine.

The constant demand for machines to give more production has led builders to lose sight of some of the essential points of a good machine; and while these new machines in many instances are called improved, it would be more fitting to call them more complicated, for all attempts at simplicity, which is so essential in a good machine, are thrown aside.

The illustration at Fig. 8 represents a singeing machine of

the better kind, and one which is readily understood and operated. The goods are laid out on trucks in even folds, and as much as possible without wrinkles. The ends being laid out are sewn together, so that the seam will be on the back. This is necessary in order to prevent the loose threads usually found at the ends from catching fire, which if not noticed is likely to cause damage. In the diagram at Fig. 9 the traveling of the cloth is shown. Starting from the truck M the cloth goes to and over roll N, then to and under A, thence to and under B, to and over C, then to and under D, from there to E, under F and over G, to and between H and I, and to and between J and K ; then down through

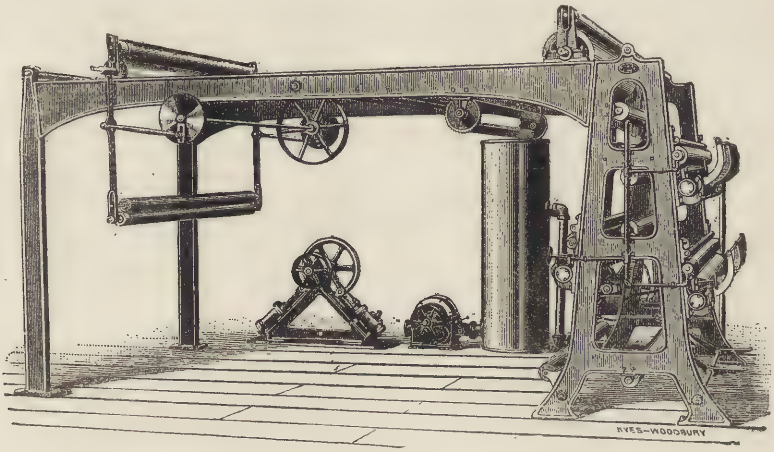


Fig. 8. Gas Singeing Machine.

the folder to the truck. The rolls C and E are hollow brass tubes, and on these the flame acts ; consequently a stream of water is constantly maintained through them to keep them cool. By referring to the illustration of the machine it will be seen that these rolls are piped.

The little donkey engine, shown at Fig 8, furnishes the requisite power, and also drives the fan in front of the tank which forces the air into the tank for use with the gas. This tank is usually supplied with a safety valve. A long apron is used on the machine, to save the trouble of threading for every batch.

When the goods are started and the apron is on the truck, it

is separated from the piece and sewn on to the other end of the goods remaining on the truck M; thus when the batch is run and the machine stopped, it is threaded ready for the next batch. If everything is ready for a start, the gas and air are turned on and the flame lit; and here care must be used to so combine the gas and air that a clear blue flame will be the result. If this is not obtained, the goods will be smutted by the smoke of the burning gas, and the singeing will not be thorough, for the air is required to drive the flames into the crevices of the cloth, besides giving a perfect combustion.

The engine is then started, and when the desired speed is

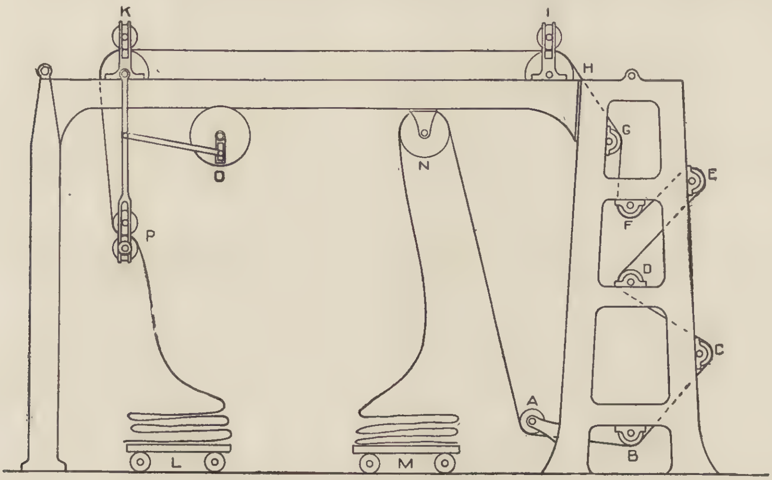


Fig. 9. Cross-section of a Gas Singeing Machine.

obtained the machine is set in motion. As soon as the apron has passed the lower roll B the flame is put on the goods by turning it towards the roll B, and after the cloth has passed B the flame is put on at E, and the process is in operation. After the goods begin to fold on the rear truck L they should be examined at once to see if the singeing is as thorough as it should be, and if not, the speed must be reduced until the singeing is thoroughly done. The process is very simple, but effective.

Plate Singeing. The diagram, Fig. 10, will give an idea of singeing as performed by means of plates. The retorts A and B are hollow, of the shape shown, and are of the maximum length

to correspond with the width of the widest goods to be treated. A flame of gas or fuel oil is forced into these retorts, and they are thus heated to a red heat. The cloth travels from the truck to and over roll C, to and under O″ and E″, up and over F″, down and under G, to and under H, up and over I and J, and then down and through the folder K, and is then folded off on a truck or in boxes.

On men's wear goods the plate singeing process is seldom used, for gas singeing is generally found more convenient and easier to install. On ladies' dress goods, however, it is frequently used, as these goods are usually finished in large establishments. This is also due to the fact that dress goods are often composed

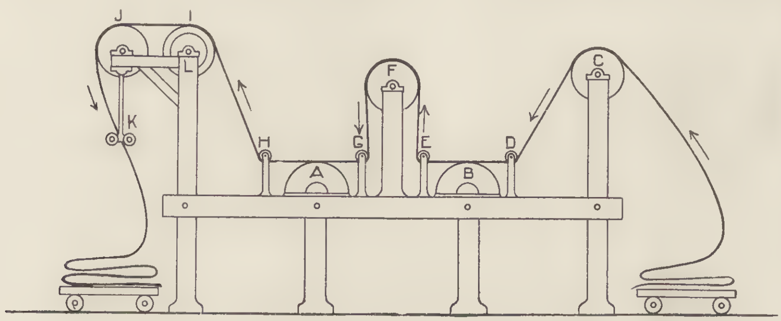


Fig. 10. Cross-section of Plate Singeing Machine.

partly of cotton, and on them plate singeing is found to be of more advantage, as it imparts a better feeling to goods containing this fiber. Outside of this fact, however, the gas singeing machine, as shown in the illustration, is adaptable to any and all kinds of goods where singeing is of benefit.

CRABBING.

Theory. The crabbing machine, which comes next under consideration, is used to impart to the goods a certain stability, and to set the weave in such a manner that in the following processes it will not be obliterated. It is also of great benefit to worsted goods where the listing has a tendency to curl, and it sets it in such a way that the following process will have no ill effects upon it. The crab is used more on dress goods than it is on

men's wear, and on them it is rarely used except on some kinds of worsteds. For men's wear the steam lustering process is generally practiced, and will be thoroughly described later.

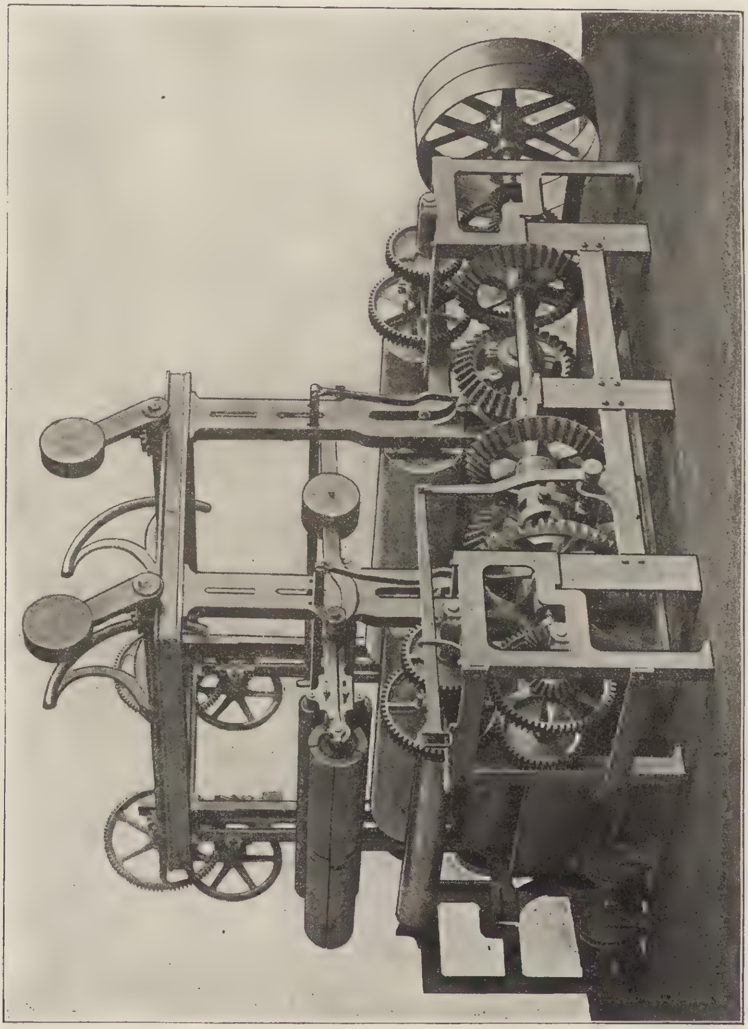


Fig. 11. Crabbing Machine.

The accompanying illustration, Fig. 11, may be described as follows: The process consists of two operations, which may, however, be carried on at the same time. The first is the loosening process, and the second the setting process. The goods are

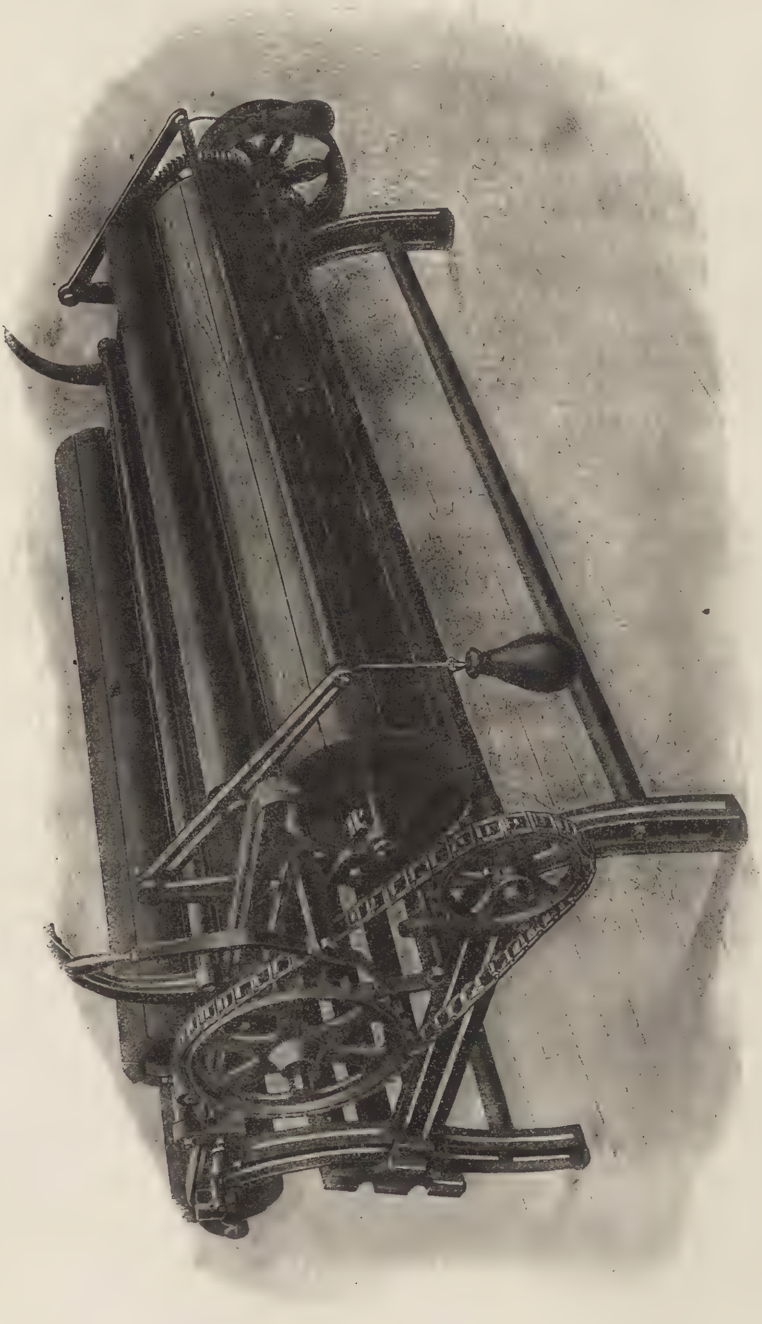


Fig. 12. Stretching and Rolling Machine.

first run on the cylinder under a moderate pressure of the top roll. They are kept tight and free from wrinkles, and pass over the several rolls as indicated. The trough, or bowl, as it is termed, in which the cylinder is immersed, is filled with hot water at about 150° F., and after the goods are in the bowl they are allowed to rotate in this hot water for about twenty minutes, and are then wound off on wooden rolls and stood on end after being wrapped. All the sizing which is in them will in this way become well loosened, and when they have thus stood for an hour or two, during which time they are turned once end for end, they are taken to the machine again and wound on the cylinder once more with somewhat increased pressure on the top roll. At this second treatment the water is kept boiling.

This is the setting process, and in order to be effective the temperature must be kept at a good boil, for if it is not, the effects of the following processes will undo what has been accomplished here. The rule is that the temperature during this process should be as high as that of any other subsequent process through which the goods pass, and as the coloring is in this respect the hardest on the goods, and they are here subjected to boiling, it follows that the setting process must also be performed with boiling water. Twenty to twenty-five minutes are required to set the goods properly. They are then taken off, being ready for the next process, which is usually the scouring, and of which due mention will be made in the treatment of dress goods.

The pressure required on the goods to give the desired finish is one of the things which is of most importance, but cannot be explained properly, as this can only be acquired by actual experience; however, it should be remembered that the higher the pressure the higher the finish will be, but the capacity of the goods must be taken into consideration.

The two processes just described, that of singeing and crabbing, do not exactly follow the other processes described, but are inserted here as belonging to the wet finishing.

STRETCHING AND EXTRACTING.

Stretching and Rolling. After the goods have passed through the washing they are naturally in a ropy form, and will have to be

opened out and nicely folded on trucks, after which they are taken to the stretching and rolling machines, an illustration of which is shown at Fig. 12. It is not necessary, or rather should not be, to stretch them in length, but they must be stretched in width. This is not performed on account of the width, unless the goods come narrow, but to free them from wrinkles sustained by their passage in the washer in the form of a rope, through both warm and cold water; on highly finished goods these wrinkles are likely to show when the pieces are finished. All classes of cloths are not treated in this way, but on goods that need gigging it must not be omitted.

The machines are supplied with two stretch rolls, between which are perforated pipes to introduce steam to the goods, if necessary. The pieces are strung over and under the bars, and then pass to the first stretch roll; from this to the second roll, and they are then wound on a wooden roll placed upon a drum and held down by the side arms. The weights attached to the ends of these arms cause the cloth to be wound tightly and smoothly. When the piece is on the roll it is taken off, and an empty roll is put in its place for the next piece. The rolls with the cloth upon them may be stood on end until they are needed, or they may be laid down flat on skids; if left that way over night, they will be found in the best condition for either the gig or napper.

If, however, it should be necessary to use the goods at once, they should be taken to the squeeze rolls. These are simply two heavy iron rolls about a foot in diameter, one above the other, and from which greater pressure may be obtained by means of screws applied to the top roll. These rolls are neatly wound with about seven or eight thicknesses of cotton cloth, which are tightly wound around each roll without any wrinkles or creases, in order not to leave marks on the goods. The cloth before entering the rolls passes over a stretch roll of regulation make, and thence through the rolls in a smooth and even manner to the other end, where a folding attachment folds off the piece in a nice even pile. This acts as a huge wringer, except that the goods pass through smoothly and at the full width.

Extracting and Squeezing. If one of these machines is not at hand, the goods may be placed in the "Hydro-extractor" and

about half the water extracted (see Fig. 13). They may then be put on the rolling and stretching machine, after which they can go to the gig at once.

The "Hydro-extractor," as it is termed, or, more commonly speaking, the water-extracting machine, is composed of a wire basket, through the center of which runs a shaft. This shaft revolves in a journal on the bottom, called a "step," and is also

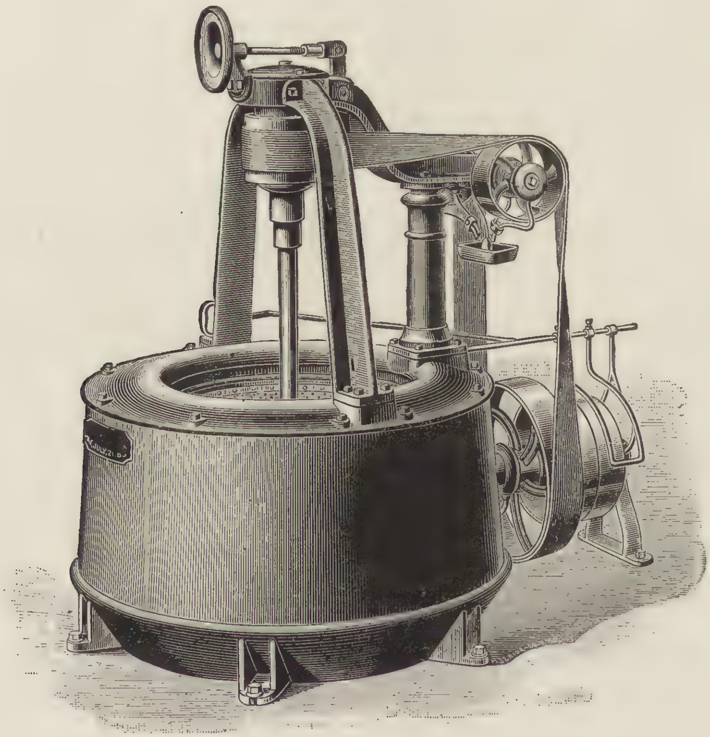


Fig. 13. Hydro-extractor.

firmly held by another journal on top. Below the top journal is a pulley firmly fastened to this shaft, and when a belt is placed around this and power applied, the basket rotates on the shaft and is driven at a very high speed, about 1,500 to 2,000 revolutions per minute. There is thus created enough centrifugal force to

throw the water out of the goods and through the apertures in the basket to the outside. The basket is set in a cast-iron box on a solid foundation, and the water thus finds its way to the bottom and is drawn off.

The goods which have been rolled up and which are to stand on end, instead of lying flat, should be turned at least once in six hours, or else they will be more moist on one side than on the other.

GIGGING AND NAPPING.

Gigging. The next step in the process of finishing is the gigging. This process consists of the combing out of the fibers on the surface of the goods. The felting together of all the fibers enhances the value and strength of the cloth, and those which lie on the face of the goods are straightened out, either to be left on as part of the finish or else to be removed by the shear. This shows that the manner of doing this part of the work has an important bearing upon the ultimate finish; in fact, the gigging is what produces the finish. The underlying principles of the process remain the same, no matter what the finish may be. The process of gigging, therefore, admits of an endless variety of methods, all based upon the same principle,—that of raising the felted fibers on the face of the goods and combing them out, so as to have them all lie in one direction.

"Teasels," the dried flower heads of a plant of that name, through cultivation are brought to a high state of perfection, and are largely used for this work. For gigging, the teasels have to be mounted in flats, or slats, as they are severally termed, which are simply wooden or iron frames, into which the teasels are crowded very tightly and evenly.

Flats. The illustration at Fig. 14 gives an idea of the frame. It will be seen that this is divided into four sections by means of rods passing through the lower and upper bars, and which hold these bars apart and in their place. The projections of the rods at both top and bottom fit into slots on the cylinder of the machine on which they are used, and thus hold the frame in its place on the cylinder. On wooden flats the connecting rods are screwed to the bars at top and bottom. With iron flats the top bar is of one piece, curved so as to hold the top of the teasel, while the

bottom is made of two pieces, to admit of the stem of the teasel being put through it and cut off evenly below. The top bar of the wooden flat as well as the bottom one is hollowed on the inside to hold the teasel more firmly; the stems of these should be cut off before mounting them. The iron flats are by all means to be preferred, as it is easier to mount the teasels in them, and when mounted they will hold them better than the wooden flats.

Teasel Mounting. There are two ways of mounting the teasels in the flats, one of which is to either moisten the teasels slightly or to steam them before mounting; the other is to use them in the dry state. The former enables the operator to handle the teasels easier; but while it makes the mounting easier it causes more work afterward, for they have to be thoroughly dried again before using on the machine. More teasels are made useless by moisture than by wear, and therefore this method is not to be

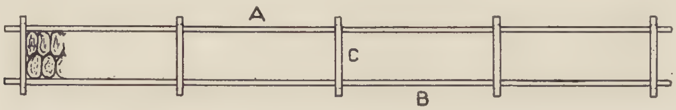


Fig. 14. Teasel Flat or Frame.

recommended. Still it is practiced in many places, though a source of much expense. It is harder to mount the teasels in the dry state; but by so doing the whole usefulness is retained, and the labor of drying the flats can be saved at this point.

In mounting teasels it is essential to have a correct eye for size, otherwise valuable time is lost by not selecting the correct size quickly. If the teasels are picked up indiscriminately as to size and thus set, the flat will create bad work and leave the goods streaky, for the larger teasels will go much deeper than the smaller ones. The teasels must be crowded in as tightly as it is possible to get them, for in using on the machines there is quite a strain on them, and if not crowded in tightly they will fly out, leaving holes in the flat without teasels.

Many times it is found that, to save money, small teasels termed buttons are furnished, which perform the work very imperfectly. This practice is what may be termed mistaken economy,

for only those teasels should be mounted in the flat which will do the work the flat is intended to do. The most economical way is to buy teasels ranging from $1\frac{1}{2}$ to 2 inches in length. These graded teasels cost a little more, but are the cheapest in the end; they will make a better and evener flat, and each teasel will perform its intended work; there will be less trouble from streaks, and all the teasels in the box may be used up, none being thrown away. Using buttons amounts to nothing less than throwing away good money on poor material. It must be remembered that these small teasels are not as well matured as full-grown ones, and are, therefore, soft, open, and useless for all practical purposes except to hold in place the teasels which do the work.

Only a short time ago it was considered that nothing but the imported teasels were fit to use, and many still cling to that notion; but New York State teasels have been grown to such perfection that it is useless to import the others. Of late years a teasel grown in Oregon is finding much favor for gigging, and bids fair to supplant the New York teasel, as it is in all respects very serviceable and uniform. The Oregon teasel is of finer grain than any other grown in this country, and on fine work cannot be surpassed.

Up-and-down Gig. The machine on which the teasel flats are to be used comes next under consideration. The oldest machine used for this purpose is the up-and-down gig; next to that comes the rotary gig, and finally the double-cylinder rotary gig; all of which may be found in actual use at the various woolen mills in the country. Progressive managers have gone from one stage to another as the improvements were made, and many to-day do not operate teasel gigs, but use the latest improved napping machines. As stated, any of the machines mentioned may be encountered in the mills, and therefore it is necessary to know how to proceed on any one of them, for it is not often that the machines of one's choice are furnished.

With the old up-and-down gig, the illustration at Fig. 15 gives a fair idea of its operation. It will be seen that the cloth winds around drums, either at the top or bottom, and when winding on one drum it leaves the other. The operating mechanism is an upright shaft, which, when turned, engages one gear and at the

same time releases the other. When it is required to stop the cloth the handle is turned to the center, thus releasing both gears.

To get a good idea of the running of this machine, it is necessary to follow a piece through the operation. Standing in front of the gig the cylinder turns toward the operator with a

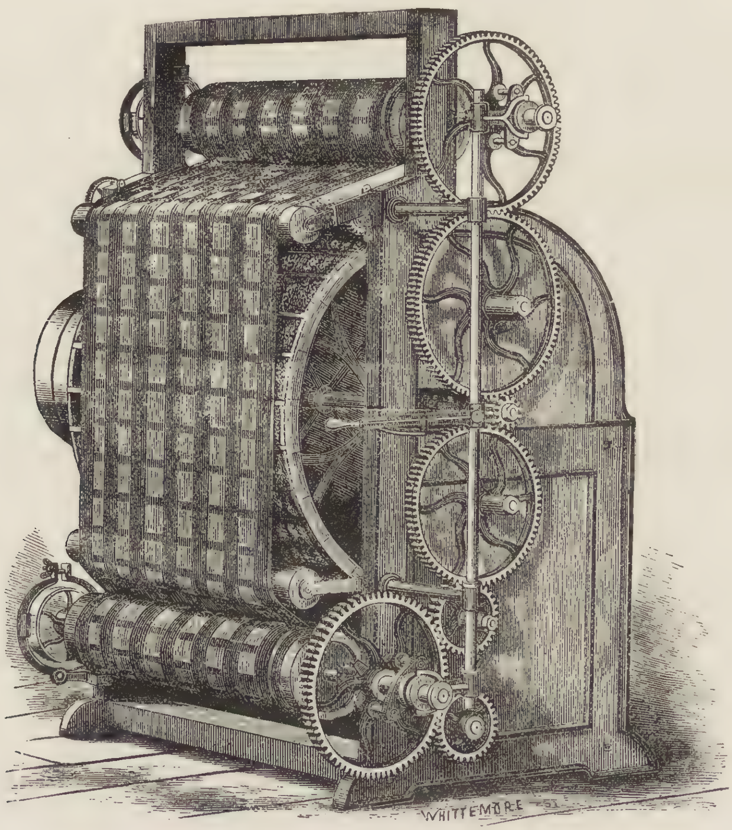


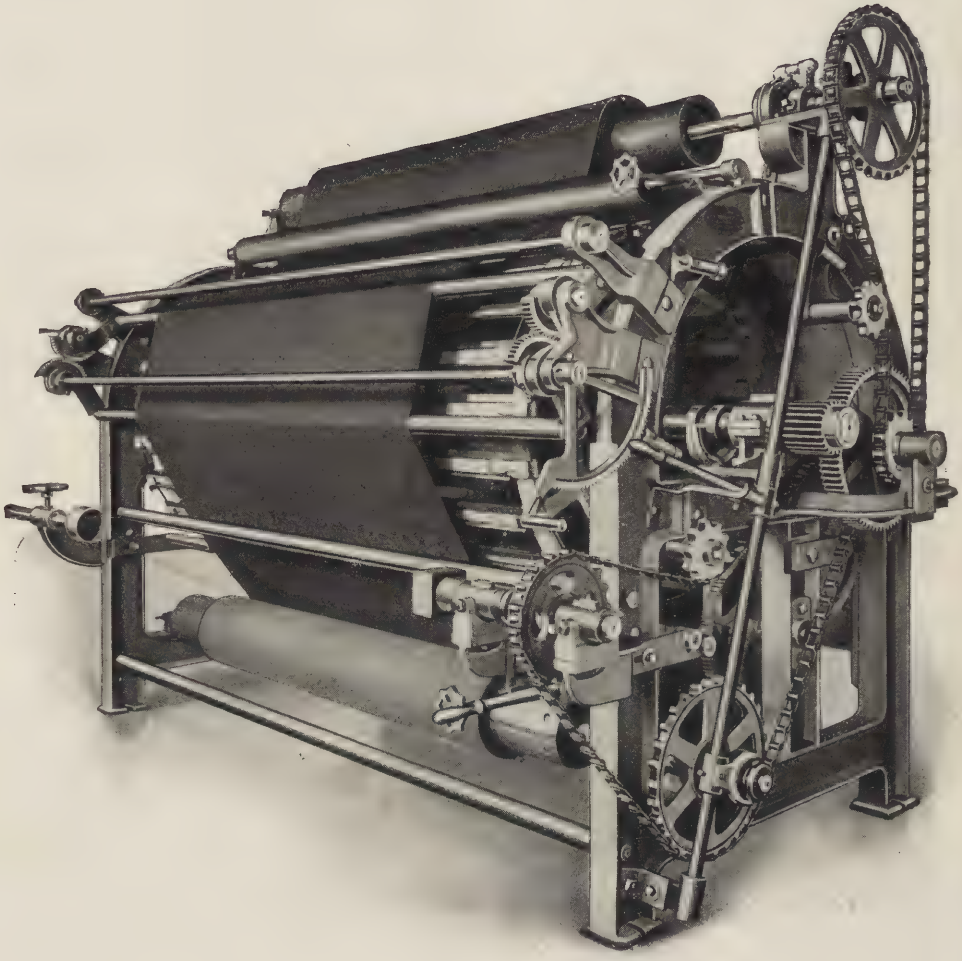
Fig. 15. Old Up-and-down Gig.

downward motion, and upon examination it is found that on the cylinder are either 24 or 28 places fitted to receive the flats, into which the teasels have been mounted, as before explained. The cylinder is provided with the flats, and care must be taken to have them securely placed in their respective slots. If this care is

not observed, one or more of the flats may fly out, doing damage to both cloth and machine, and also perhaps to the operator.

When this has been carefully seen to, the piece is either sewn or wired to the apron of the top roller or drum, and is then wound evenly on this roll by starting the machine and engaging the upper gear by turning the handle outward. When the end comes, stop the top roll by turning the handle to the center, and then sew or wire the end of the cloth to the apron of the lower roll. By turning the handle inward the bottom roll will revolve and the cloth wind around it, taking it from the top roll and passing in front of the cylinder. Below the top roll are found two projecting arms, into which a roll is fitted, and over which the cloth passes before going on the top roll. These arms are supplied with a sliding arm running on gear teeth, and which can be slid in or out, thus bringing the roll over which the cloth has to pass, either closer to the cylinder or farther away from it, and of course the cloth with it. Just above the bottom roll are found two similar arms holding a roll, and over which the cloth passes before going on the roll; but this carrier roll is stationary. This provides the means of bringing the cloth into contact with the cylinder or taking it away from it. As soon as the cloth commences to travel to the lower roll it is brought slightly in contact with the cylinder by means of the sliding roll mentioned; but this contact must be very light at first. After the piece is all on the lower roll the handle is reversed and it begins to go upward onto the top roll. Then the cloth may be brought into a closer contact with the cylinder, and after this it is brought a little closer at every run.

The passage of the cloth from the top to the bottom roll is called a "run," and by it is measured the amount of work to be given; thus the piece at this stage is given six runs; that is, it travels from top to bottom and back to the top again six times. When this has been accomplished the machine is stopped, the cloth separated from the lower apron and nicely folded on a truck by pulling it from the top roll until the apron comes; this is also separated from the cloth. The piece is now turned upside down and the truck turned also, so that the face of the goods is towards the machines. By this time it will be found that the cylinder has gathered flocks in greater or smaller quantity. If



UP-AND-DOWN TWO-CONTACT GIG WITH ROLLING ATTACHMENT, CYLINDER VIBRATOR, ONE-CONTACT ATTACHMENT AND SPRINKLER PIPE

Parks & Woolson Machine Co.

the goods are not too wet when going to the gig the teasels should be dry enough for another six runs; but before putting the cloth on again a hand card, such as is used in the card-room for stripping, is used for removing the flocks from the teasels. In large establishments this is done by the use of a revolving brush, after which the flats are turned so that a fresh and dry side is presented again for the work.

Before proceeding further with the illustration, it is necessary to state that in the gigging of all kinds of cloths the process is always begun with the poorest kind of flats obtainable; that is, those which are shortly to be rejected as unfit for further use. These are called "poor work," while new flats are called "sharp work." When starting a piece be sure that the cylinder is clothed with poor work, for if sharper work is used it will only be to the detriment of the goods as well as of the teasels. It must be remembered that the fibers are all felted together, and anything that will take hold too hard will tear and break them, and will also break off the points of the teasels which are needed to do the combing out. Consequently some system should be employed to grade the different flats so as to proceed with the work gradually, and not wear the cloth or teasels unduly.

The cylinder is often divided into several subdivisions, containing an equal number of flats in each. For instance, a cylinder containing 24 flats may be divided into 4 or 6 equal divisions of 6 or 4 flats each. On goods that are gigged for a clear finish and which are usually not as heavily felted as face goods, the latter division is the most acceptable, while on heavily felted cloths it is better to make 4 divisions of 6 each. The flats are then graded according to the amount of work they have already performed; the last is termed poor work, the next in order is styled No. 1, then No. 2, No. 3 and No. 4, with the remaining class being called fresh, new, or sharp work. Thus it will be seen that it is an easy matter to so instruct the operator that the gigging may go on without the constant presence of the overseer. This should be properly understood, for without a system and the proper grading of the flats it is next to impossible to gig two pieces alike. Some teasels wear out faster than others, and therefore a careful watch

should be kept on the different grades to keep them up to the standard.

When the cylinders have been filled with poor work and the piece has received 6 runs one way, it is run on the top roll again after it has been turned as stated. This is termed "reversing," and when the teasels strike the cloth thus, the fibers before raised will be turned the other way. The piece is again given 6 runs and is again taken off and reversed, bringing it this time as it was at first. For this illustration a piece of cassimere with a clear finish is used, and for that reason the cylinder is divided into 6 sections of 4 flats, each, thus making 4 grades of flats beside the poor and new work. Now take out one of the old flats and put in its place one of No. 1 grade, count off 5 flats and remove the sixth and replace with another of No. 1, keeping on this until 4 flats of No. 1 have been placed in the cylinder. Put the cloth on again and give 6 runs; reverse and give 6 more, after which the cloth is again reversed, and this time 4 flats of No. 2 grade are placed in the cylinder next to the No. 1's last put in. Repeat the operation as before; when the last grade or new work is put in, give the cloth 12 runs one way, instead of reversing after 6 runs.

The cloth is then carefully examined to see if all the fibers have been lifted and the thread is round and clear. To do this run the blade of a penknife under the nap to lift it up, when it will be readily seen if the threads are clean and round or if fibers remain untouched. If all is clear, as it should be, the goods are taken off and sent to be speck-dyed, and if not, give them more runs with the sharp work until well cleared. At several stages of the process examine the goods to see if they are clear enough, for if more runs are necessary they should be given before the sharpest work is introduced, so that the strength of the goods will not be injured. Always endeavor to keep the whole strength of the goods intact; nothing is worse than tender cloth.

In the examination to see if the gigging is done properly, it is useless to pull the nap and shave it off with a knife, for there is nothing to prevent the taking off of fibers which have not been properly raised. Although the place examined may look well enough, the piece often fails to clear up properly when sheared, making it necessary to either scrape it very hard on the shear or

else give it an additional dry gigging. There is no excuse for this, and it can be easily avoided by testing in the manner previously described.

While the above is given to show how the gigging is performed on the old up-and-down gig, it is not intended as a sure and infallible guide; for, as already stated, to perform the operation successfully no hard and fast rules can be laid down. Each man

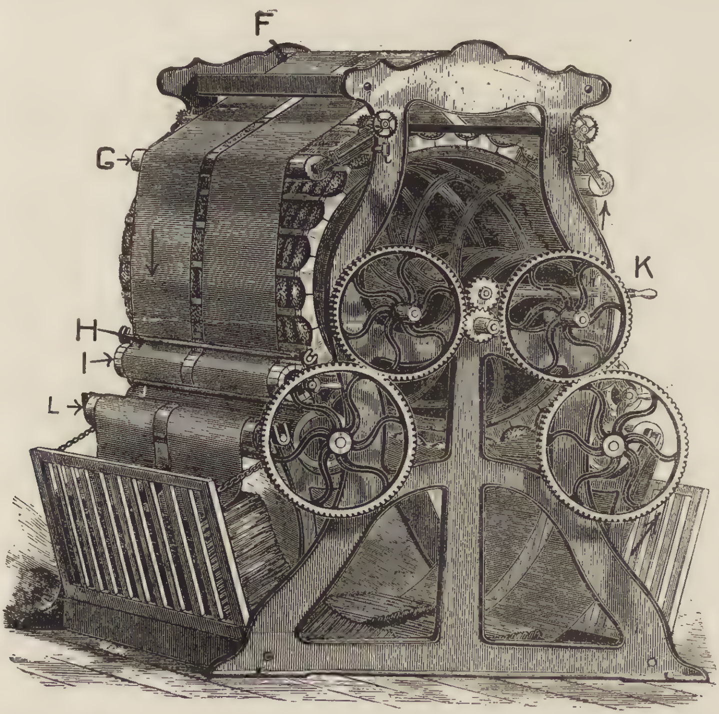


Fig. 16. Rotary Gig.

should evolve his own rules and system with especial reference to the goods in hand, and even after he has done this he will often find that it is necessary to depart from them to better some conditions that have not before arisen.

The Rotary Gig is the next machine for consideration. A glance at the illustration will show the difference between this and the up-and-down gig.

Fig. 16 shows this machine with two pieces of narrow goods

all strung and ready for gigging. On the left side are the driving pulleys. They consist of two loose pulleys and one tight pulley in the center. One of the loose pulleys is supplied with a straight belt while the other loose pulley has a crossed belt. By this it will be seen that the cylinder can be driven in either direction by using either one or the other belt. By referring to Fig. 17 the cloth is shown to be threaded as follows: Over idler roll, A, in front of cloth roll, B, and under same; then up and over stretch roll, C, and back of bar, D; thence up and over application roll, E, and to and over roll, F; then down and over application roll, G, to bar, H, over stretch roll, I, to and around cloth roll, J, and over idler roll, L, and into the scray. The cloth can be made to travel in either direction also by raising or lowering lever, K, thus engaging either one or the other train of gears. When running the machine have the cloth travel in the opposite direction from the cylinder. Upon changing the direction of cloth and cylinder all of the flats must be reversed.

The cylinder of these machines is usually fitted for 24 flats, and at the start it should be filled with poor work, as on the first machine. The cloth is then passed through the machine in the manner indicated in Fig. 16, after which the two ends are nicely sewn together. This is preferably done with the sewing machine, although a fair seam can be made by hand. It should be strong and durable, and made in such a manner that the stitches lie on the back of the goods, in order to reduce the wear occasioned by the teasels as much as possible. All seams should be on the back of the number of pieces placed on the machine. These machines have a capacity of two or more pieces. This of course is regulated by their length as well as by their general bulkiness. Four pieces of light weight goods can easily be accommodated.

After making sure that the flats are put in properly, the machine is started with the straight belt. By examining the teasels in the flats, it will be found that if they are rubbed from the top toward the stem, little resistance is met with, but as soon as they are rubbed from the stem toward the top, the several teasel points are called into action and fasten themselves into the hand. So when standing in front of the gig, that is, on the side where the cylinder turns toward you, make sure that the teasels in all the

flats have the stems down and tops up. If this is not observed the gigging will be of no value, for the teasels will slide over the cloth without raising the fibers.

After the cylinder is in motion, start the cloth and bring it gradually in contact with the cylinder. Unlike the other machine, one run is the traveling of the cloth once around the machine, so that if more than one piece is put on, careful account of the seams

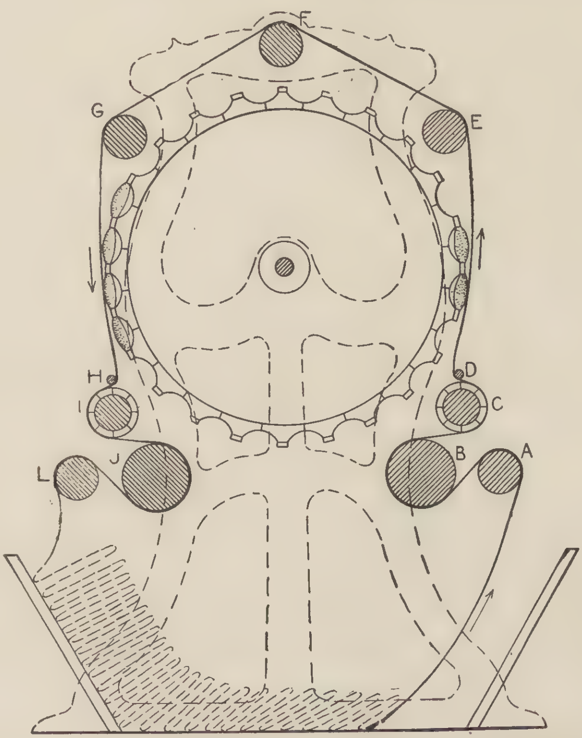


Fig. 17. Sectional View of Rotary Gig.

must be kept. To accomplish this the first seam is usually marked in such a way as to be easily distinguished from the others. Consequently in order to give the pieces the same amount of work as on the up-and-down gig, it would seem that the pieces should be run 12 times around the machine, but on account of the increase in the number of contacts this is not the case. The least number of contacts on these gigs is two, and the greatest, four; this must

of course be taken into account when gigging. On a two-contact machine the same number of runs will be required as on the other machine, but it is done in half the time.

When the goods have received this treatment, stop the machine and loosen up the cloth so that it may be laid on one side; then take out the flats one after another, and turn them upside down, so that the teasels will lie in the opposite position from the one they occupied during the first run. Next straighten out the cloth and start the machine with the crossed belt, which will drive the cylinder in the opposite direction. When the cloth is started it also travels in the opposite direction. This is the reversing process as performed on the other machine. It will be noticed that the cloth is not taken off the gig, nor is it turned and put on the machine again, all of which is a distinct saving of time and labor, beside the increase in contacts, which still more reduces the time required to perform the gigging.

In proceeding with the gigging on this machine the same practice is observed as to the increase in the efficiency of each succeeding set of teasels. In fact the whole treatment is the same, but the process is shortened by the time saved in taking the goods off and putting them on the machine again, and also in that more than one piece can be treated at the same time. The principle of the gradual increase of the sharpness of the work, and also the bringing of the goods into contact with the cylinder, remains the same, regardless of the kind of teasel gig machine which is used.

Many styles of these single rotary gigs are in use. The principles are the same in all of them, the difference between them being simply some minor details which have no actual bearing upon the process.

Double Cylinder Rotary Gig. This machine differs materially from each of the preceding gigs, and looks more complicated than it really is. (See Fig. 18.) In threading the machine the goods are put in the scray at the back or left side, and pass over the square roll found at the bottom right-hand side. This square roll lifts the cloth from the bottom of the scray, thus aiding the driving part and lessening the strain on the cloth, thereby keeping the tension more uniform. From there the cloth passes under the

roll at the right corner, and over and under or back of the other roll and bar, which is set into a frame swinging on the axis or the lower roll. The bar is corrugated, and aids in taking out wrinkles. From there the pieces pass up and over an idler roll, and thence around the cloth roll, which is actuated by the chain from the back roll, thence up and over stretch roll, F, down and back of a brass-covered bar, and thence to the application rolls, *d*. There are four application rolls for each cylinder actuated by a worm

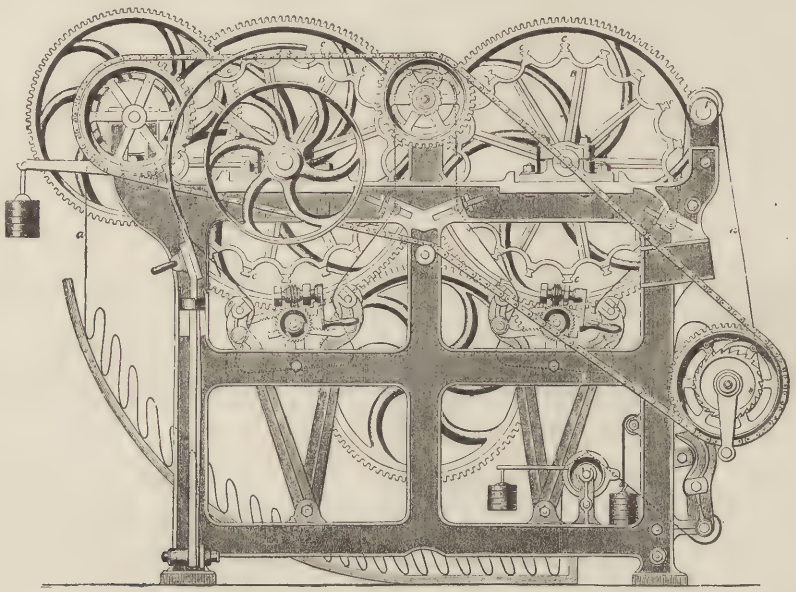


Fig. 18. Sectional View of Double Cylinder Rotary Gig.

and gear. The cloth passes over the first and under the second application roll, and thence to the third and fourth. It then passes upward and back of another brass-covered bar, and up to the middle cloth roll, which is also a stretch roll. By this it will be seen that the cloth has four contacts with the cylinder, B, and the flats which are fastened upon the arms of B at C. The cloth travels the same way substantially, until it passes the last brass-covered bar, and then goes to the back cloth roll. By referring to Fig. 19 which presents the other side of the machine, the driving gears of this back cloth roll are seen at the upper right hand. After the cloth passes around the back roll it is taken by a smaller roll

immediately below, and goes from there over another small roll and thence into the scray.

This right-end view shows plainly the means by which the cylinder is actuated, and the way in which the gear of the front cylinder is moved by the screw seen near the axis of the gear. As shown by the illustration, two cylinders instead of one perform the work on this machine. Each of these cylinders, being somewhat smaller than those of the other machines, holds 18 flats. The cylinders revolve in the same direction, or in opposite directions, at the will of the operator, so that the work of straight and reverse gigging may be carried on at the same time. The rear cylinder is the one to which the power is communicated by the belt, therefore this will always run in the same direction; but the front cylinder is operated by gears from the rear cylinder, thus making it run in the opposite direction from the rear one. The gear on the front cylinder is movable, and can be disengaged from the other by sliding it out on the shaft. This is done by means of a screw. If the front cylinder gear is disengaged from the rear one, the front cylinder will stand still; but if a gear which is placed lower down and which has a wide face, engages the gears of both cylinders, the cylinders themselves will run in the same direction.

A double-cylinder gig, so far as putting in the flats is concerned, is treated as two gigs. The flats of the rear cylinder are put in from the back, while those of the other are put in from the front, the cylinders in each case turning toward the operator. Having only 18 flats on each cylinder, a division of 6 sections makes the number of flats in each section too small; therefore the cylinders are divided into 3 sections of 6 flats each. As this gives only three grades of teasels it is customary to treat the two cylinders as one in this respect and have 6 sections of 6 flats, each making six grades as before. They can also be divided into 2 sections of 9 flats each, making for both cylinders 4 sections, with 4 grades of teasels. The latter plan is most frequently adopted, and therefore will be used in the following example.

Four pieces form a string on this machine on account of the space below being large enough to accommodate four pieces without crowding. The cylinders are examined to see that both contain

old or poor work. The pieces are then run on, after which the ends are nicely sewn together, thus forming one endless string. The machine is now started with only the rear cylinder and the goods are given two runs. The cloth is brought in contact with the cylinder lightly by the mechanism supplied for this purpose, and when the machine is stopped at any time the cloth is removed from contact so that in starting again it may not catch. This precaution is not generally observed, and often results in damaged goods. After giving the pieces two runs with the rear cylinder

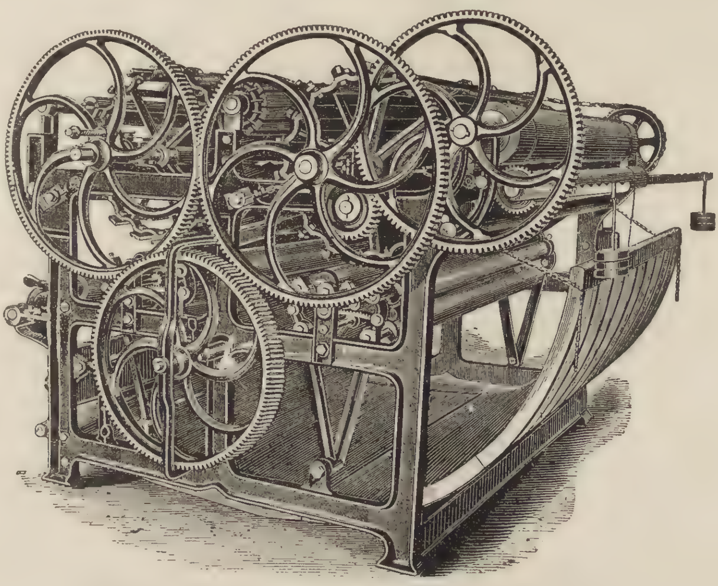


Fig. 19. Elevation of Double Cylinder Rotary Gig.

only, the machine is stopped, and the front cylinder run in to engage the gears of the rear cylinder. Then start the gig again, and this time have both cylinders in action. Proceed to draw the cloth toward the cylinders gradually, so as not to bring it in contact too hard. Give the goods 4 runs; then stop, clean the flats, and turn them over to present the other side for the work and give 4 more runs. When this has been accomplished, take out 9 flats, or every other one from the rear cylinder, and replace with No. 1's; also take out 9 flats in the same manner from front cylinder and replace with No. 2's. Now give 4 runs, clean, turn

the flats, and give 4 runs more. The front cylinder is taken off the goods after this, and the remaining 9 old flats are taken from the rear cylinder and replaced with No. 3's, or new work. Give the pieces 6 more runs, clean, turn the flats, and finish up with another 6 runs.

On cassimeres this amount of gigging will be sufficient to make the threads show full and clean; however, a careful examination should not be omitted. It will not do to give the goods a prescribed number of runs and trust to their coming out all right; this matter must be verified by examination.

Another good way to do the work is to start as before, and when changing the flats, put the same grade in both cylinders. Give the same number of runs and put the next grade (but better this time) into both cylinders, and give the work as described. Now put in a set of sharp flats, or No. 3's, into each cylinder in place of the No. 1's; run out the gear of the front cylinder, push in the lower gear, and engage both cylinders, making them both revolve in the same direction. Before starting, however, all the flats in the front cylinder must be reversed, for the cylinder will run in the opposite direction. If the flats were not reversed there would be no gigging. As both cylinders are now set with sharp work the cloth will have to be brought in contact with the cylinders very gradually. This must not be carelessly performed, for if put on too quickly, both the teasels and the cloth will be damaged. Give the goods 4 runs, bringing the cloth a little closer at every run, until at last the teasels will work well into the bottom and clear up all of the fibers.

Before starting the next set, the work in both cylinders is, of course, removed and replaced with old work; therefore there will be little likelihood of having the flats wrong in the front cylinder, as they would be were the gig started with the flats reversed. The process as described answers very well for cassimeres, but on face goods the gigging is more extended.

All gigging is commenced with old work, and as this accomplishes its mission the sharpness is increased, until at last the sharp work may be used. Practice makes perfect in this as in all other branches of finishing, and only actual experience can teach the best course to pursue in regard to the amount of work the

goods should receive. On clear finished goods, where all of the nap is removed on the shear, it matters less if fibers are pulled out, and therefore the process can be hastened. On face goods it is an object to save all the fibers possible, for they are needed to produce a good finish. The foregoing constitutes the three means employed in raising the fibers with teasels. The next machine for this work is the "Napper."

The Napping Machine. Several styles of nappers are in use, and almost everything is claimed for them, but for all practical purposes the type of which the accompanying illustration, Fig. 20, is a sample, has stood the test of practical operation as well, if not better, than any other. This napper is provided with a cylinder, upon whose circumference is mounted a series of napping rolls. The napping rolls revolve independently of the revolution of the cylinder, being driven by a mechanism for this purpose, and revolve with the cylinder, but each in an opposite direction from the direction of the cylinder. These rolls are covered with galvanized steel card clothing and are "noncorrosive" except to acids. If acid is in the goods to be treated, or in the water, these rolls have to be covered with bronze clothing, which will resist it.

Construction. The goods have four contacts with the cylinder, and pass over a large roll after each contact. On each side of these are stretch rolls, which are spiral threaded, having right and left threads. These keep the goods from narrowing or wrinkling. These rolls are driven in the same direction as the cloth, but at a greater speed, thus making sure of the smoothness of the cloth as it comes in contact with the napping rolls. Back of the cylinder is a brush roll $17\frac{1}{4}$ inches in diameter, covered with a special kind of card clothing. The brush roll lays and straightens the nap. On clear-finished goods this brush roll is not of so much value, but on face goods it is of great benefit.

The spiral stretch rolls, as well as the larger rolls over which the cloth passes are, with the exception of the first series, set upon the arch; and as this arch can be raised or lowered at will, it serves to bring the cloth in contact with the cylinder. The operator can thus regulate all of the contacts at the same time; and as the motion is positive and is provided with a dial, it is possible for the operator to always obtain the same contact of the goods. The

speed of the napping rolls can be increased or decreased, to either hasten the work or make it slower, as the case may require.

Under the cylinder is a $14\frac{1}{4}$-inch roll covered with fancy card clothing, which keeps the napping rolls free from flocks and also sharpens the clothing. The working capacity of the napper is consequently at the same standard of efficiency always. By referring to the illustrations, it will be seen that the cloth goes from the box or scray upward over the two guide rolls, down under the lower guide roll, back, and over the first spiral stretch roll; from there over the cloth roll, again to the second spiral stretch roll under which it passes, upward again to the third spiral stretch roll, over a cloth roll, and finally to the fourth stretch roll. Between the second and third stretch rolls is the first contact of the cloth with the napping rolls. From the fourth stretch roll the cloth goes to the fifth, having another contact between the two rolls. From the fifth stretch roll it again passes over a cloth roll and to the sixth stretch roll; then from the sixth to the seventh stretch roll making another contact, and instead of passing over another cloth roll it simply passes on to another plain roll, making the fourth contact of cloth. It then passes to the brush and there gets two contacts, then upward and over guide rolls to the front again, where it passes over a cloth roll supplied with an idler roll, which presses cloth to the roll to keep it from slipping. The cloth now passes down through a folder, and is either folded off on a table or into the scray.

Operation. The napping energy is increased or decreased by putting on a smaller or larger driving pulley, according to need. On the left-hand side of Fig. 20 are two large pulleys connected with a wide belt. One of the pulleys is mounted on the main shaft of the machine, and furnishes the power for the napping rolls by communicating the power first to the other large pulley lower down. The smaller this pulley is the faster it will revolve, the size of the other pulley remaining the same; consequently by putting on a smaller pulley at this point, the speed of the napping rolls is increased.

As the process is short, it is not necessary to crowd many pieces into the machine, and generally one piece is treated at a time. Then again, the absolute certainty of being able to give

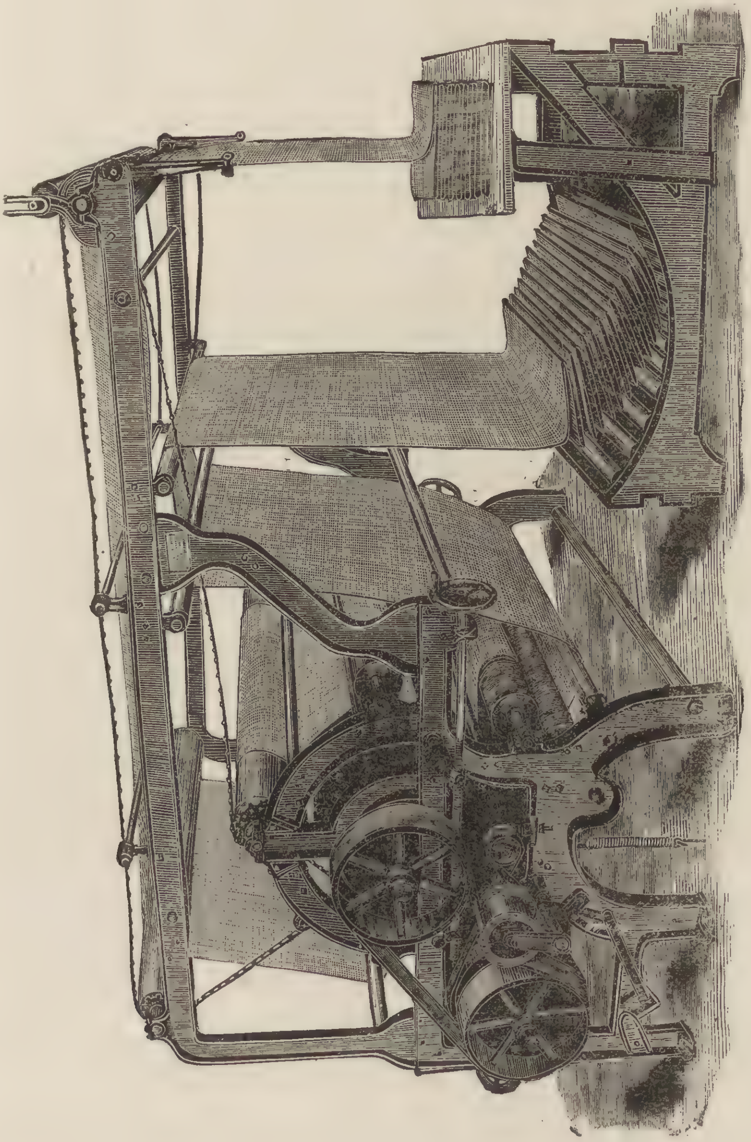


Fig. 20. Elevation of an Improved Four-contact Napper.

all the pieces the same treatment, is another inducement to put on one or, at most, two pieces. The ends of the piece are sewn together, and then the machine is ready to start. On those classes of cloth which would require the longest amount of time in the gigging process, the benefits to be derived from the use of the napping machine are more forcibly illustrated, and for that reason a piece of well-felted kersey will be used in this connection.

After the machine is started, the napping rolls revolving at their slowest speed, the cloth is put in contact lightly by lowering the arch, which brings all the contacts into action at the same time. After the piece has been once around, the arch is let down to within one or two points of its limit, and the goods given another run. The machine is then stopped, and the arch raised; then the pulley which drives the napping rolls is taken off, and a smaller one substituted. After this, the machine is started again, and the cloth brought in contact slowly to the same point, two runs being given. The speed of the napping rolls is again changed, and this time to the fastest speed obtainable. After starting, the contact is brought to its limit by lowering the arch as far as it will go, and the goods are given two more runs. The napper will then have raised a good thick nap.

As the work progresses, it is well to step back of the machine and examine the cloth as it runs, thus obtaining an idea of how much more napping the pieces require. Simple as the work appears, it admits of many changes and methods, which are often dictated by individual fancy; but whatever method is adopted, it should always be gradual.

Because the fast speed of the napping rolls is beneficial to the goods at the finishing stage, it must not be supposed that it would be so at the time of beginning, and exactly for the same reasons as explained in the gigging; but in napping there are no teasel points to break off, and therefore any injury which occurs is sustained entirely by the goods.

On such cloths as cassimeres the napping rolls may be set at a medium rate of speed, and with one or, at the most, two runs the goods will be well cleared. The napping rolls travel in the opposite direction from that of the cylinder and of the cloth. The brush lays the nap in the direction it is raised, or in the same direc-

tion as the cloth travels. The usual practice is to have the nap run from the number end, and, therefore, the number end must come last instead of first, as on all other machines.

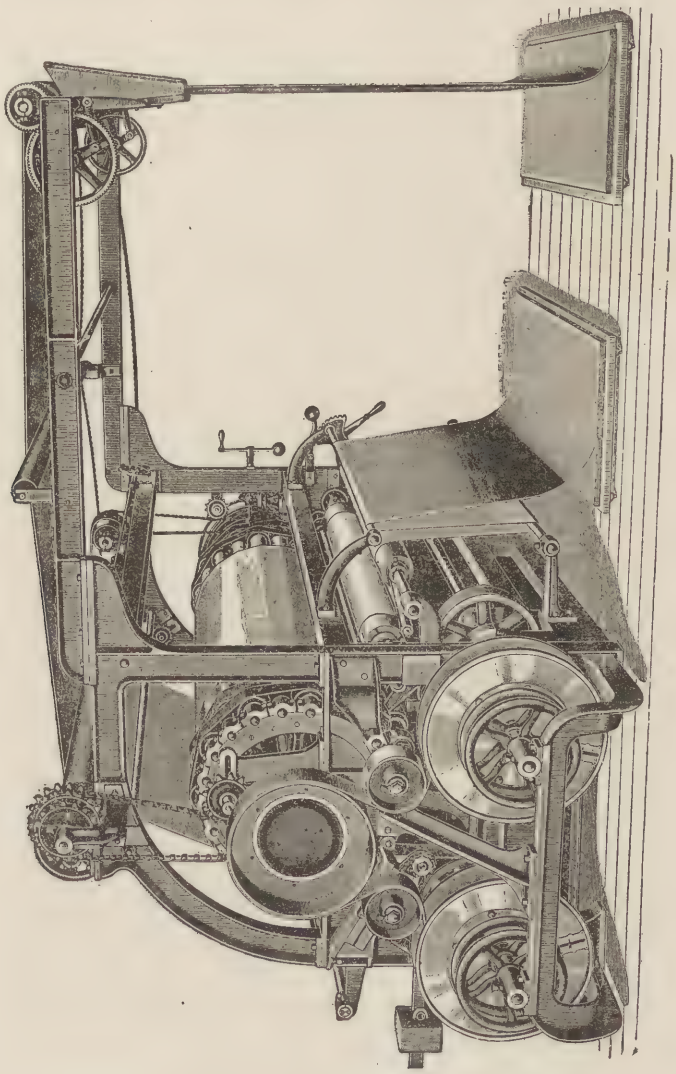


Fig. 21. Double Acting Napper.

Cropping. It is often necessary in napping, as well as in gigging, to send the goods to the shear when the process is half completed, to have part of the nap sheared off, in order that the napping wire may be facilitated in reaching the bottom.

This is termed cropping, and is not only employed to enable the teasels or wires to do their work better, but also to give the face a smoother and evener appearance. By shearing the nap down to an even length, all of the bottom fibers which have thus been raised will be retained; otherwise many under fibers will be pulled out instead of being raised, thus producing an opener and thinner nap. On very fine goods, such as doeskins and broadcloths, it is well to resort to the cropping process twice, as it will materially enhance the beauty of the finish.

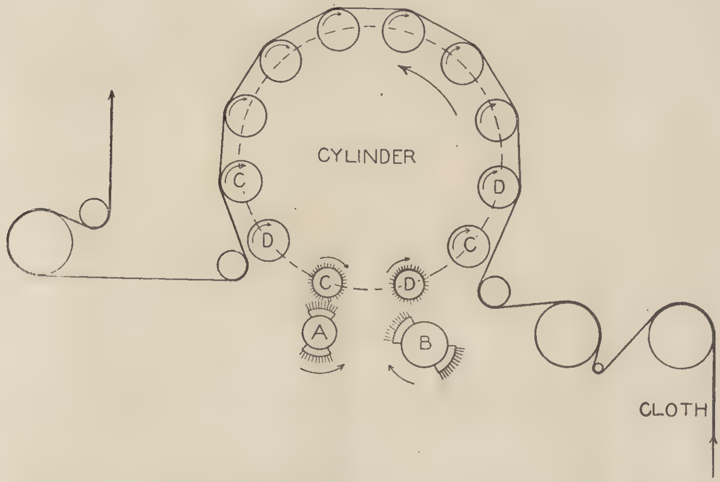
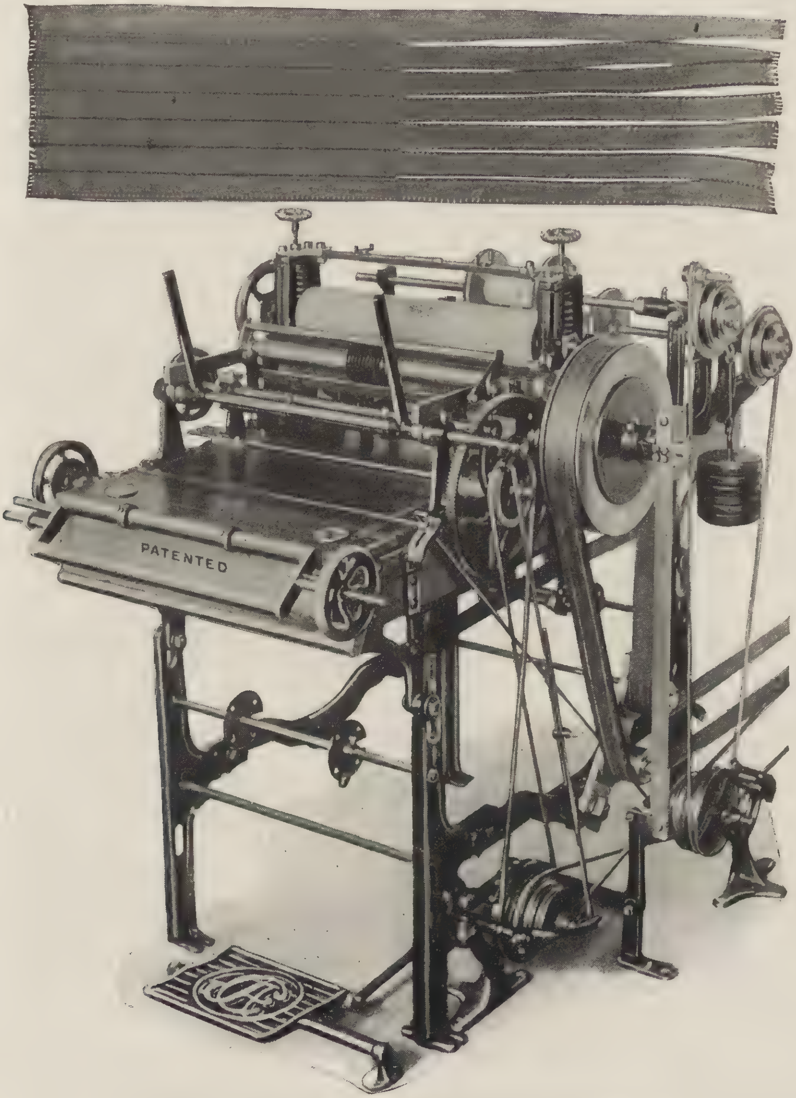


Fig. 23. Cylinder and Cleaning Device of Double Acting Napper.

Double-acting Napper. Another napper, Fig. 21, should be mentioned in connection with the napping process, which differs materially from all others, and which may be considered as the most improved of its kind,—the double-acting napper.

The diagram shown in Fig. 22 gives a fair idea of the principle of this machine, irrespective of the number of napping rolls. It will be observed that at the contact of the cloth, while the rolls travel in an opposite direction from the cylinder, every other roll is equipped with wires pointing in the opposite direction from its neighbor. The cloth is threaded and bears directly upon the major portion of the cylinder. In order to clean the two series of napping rolls, the device lettered A and B is used. These clean-



CLOTH SPLITTING MACHINE AND SAMPLE OF PRODUCT
James A. Cameron

ing rolls, positively driven, consist of brushes and blanks, and are actuated in such a manner that the brushes clean every other roll, while the blanks skip the alternate roll. The speed of both series of napping rolls is variable, being controlled by expansion pulleys.

The wire used on this machine is shown in Fig. 23. It will be observed that this is needle pointed. The right-hand side of each staple shows the needle-pointed wire, while the left point of each staple shows the diamond-pointed clothing. The centre staple gives an idea of the result of excessive grinding, while that on the right shows how dull a diamond point may become, owing to the shortness from the tip of the point to the beginning of the full-size wire. The staple on the left shows a sharp point of each type.

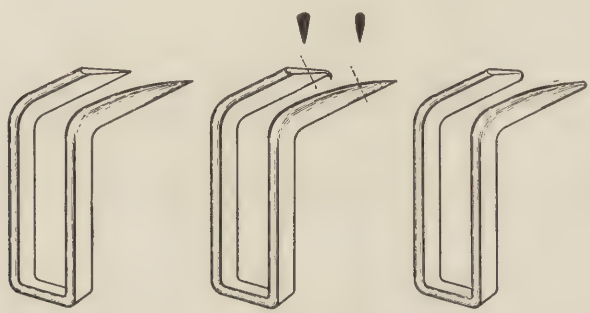


Fig. 23. **Needle and Diamond Pointed Clothing.**

While it is not often necessary on nappers to reverse the cloth and nap in the opposite direction, still it is done occasionally, to obtain the best results. On the other style of napper this is accomplished only by taking the piece off and turning it, but on this type it is performed at one operation, consequently affecting a saving of time. It also produces a different character of nap from the ordinary napper. It is shorter, closer, and more like velour, so that on face-finished goods it is one of the best machines in use. By attacking the felted fibers simultaneously, from opposite directions, they are thrown into a more vertical position, and are not drawn or combed out, as with the other styles of nappers and gigs. Consequently all goods napped on this machine have a softer feel, a fuller and better appearance, and retain longer their superior look in handling,

than any goods napped or gigged on either the ordinary or the teasel gig. There is also less pull against the threads, and, therefore, less danger of tendering the goods.

Woolen Napper. A correct idea of the next napper to be considered may be obtained from Figs. 24 and 25. This machine has sixteen napping rolls, and the cloth is brought in contact with them at five points. The relative speed of the workers around their own

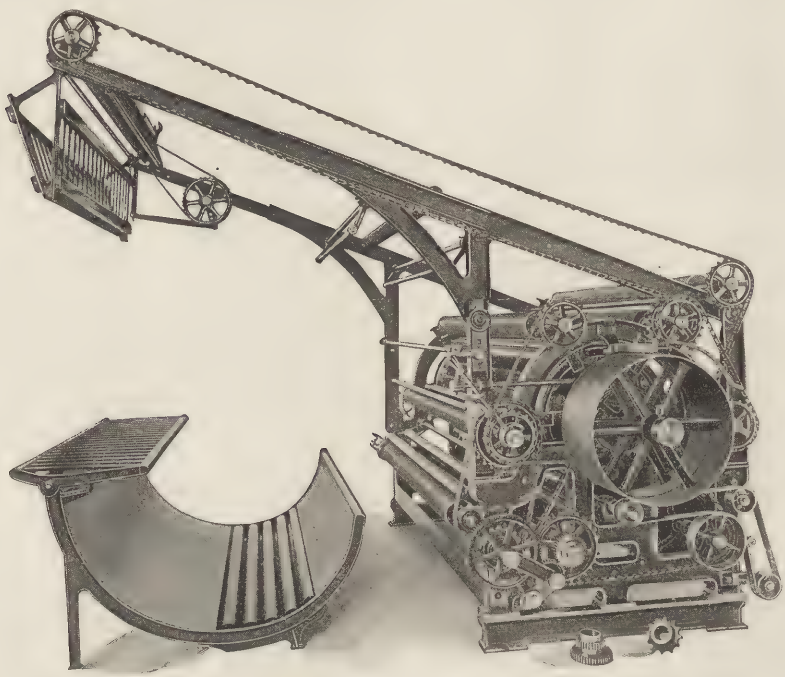


Fig. 24. Woolen Napper, Right End View.

axis, and around the drum, or cylinder axis, is governed by a train of gears on the left end, beneath the gear guard. These gears are rigidly mounted on studs set into the frame. The change gear is set on the end of the main shaft, and is connected with the train by an intermediate gear on a swinging arm, with a screw adjustment; therefore, a change of the speed of the workers can be made quickly and easily.

Another feature of merit in this machine is the cloth feed; by means of this the speed of the cloth is controlled, and can be varied

between 10 and 20 yards a minute by means of change gears. The mechanism is found on the lower front of the right-end view. The small gear at the right is the change gear.

As on the other nappers, the cloth contacts are adjusted together, and can be operated while the machine is running. A dial with an indicator makes it possible to have the same contact at all

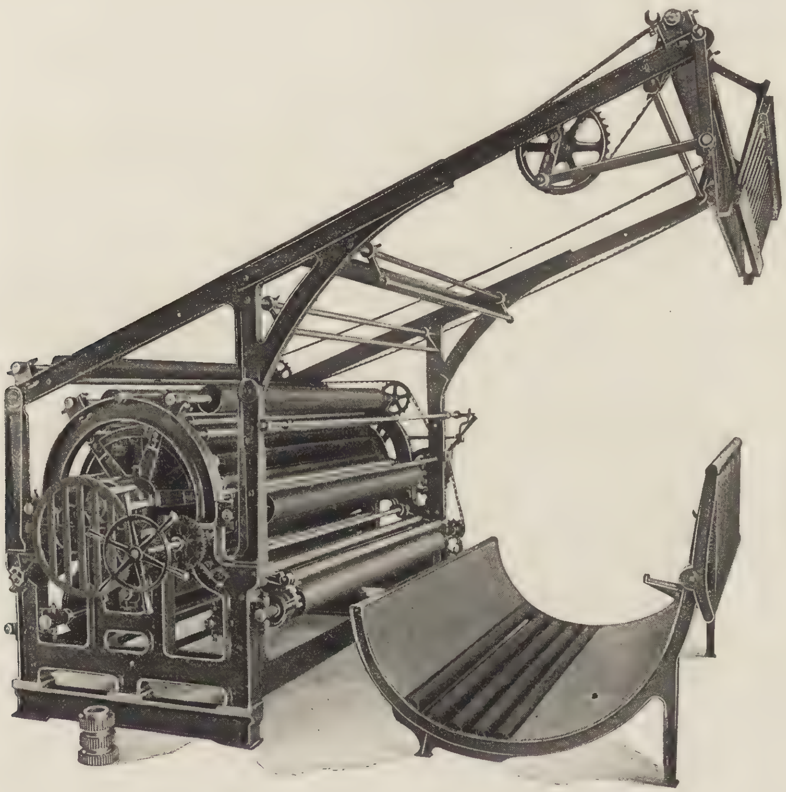


Fig. 25. Woolen Napper, Left End View.

times. The high-speed laying brush with double cloth contact on this napper is of great value in producing a fine finish. A stretch roll of very large diameter, which gives a long contact and great stretching capacity, operates on the back of the cloth just before the first contact with the napping surface. The application rolls are right and left screw threaded, and serve to keep the goods from narrowing during their passage. These rolls are brass covered, and, therefore, will not leave rust marks on the goods.

Such are the features of this machine; and with the use of either of the three styles mentioned, there should be no trouble about the quality or the quantity of the work. It should always be remembered, however, that if the work has not been executed properly in the fulling mill, the gigging process will never remedy it; therefore, examine each piece carefully before it is put on either of these machines, and upon its merits decide what amount of gigging it should receive. Each piece should also be tested as to strength, and the work of napping or gigging conducted in such a manner that its strength will not be impaired.

Dry Gigging. Before leaving the subject of gigging, a few words in explanation of the dry-gigging process are needed. While on all goods it is best to do the gigging in the moist state, circumstances will arise which make it expedient to depart from the general rule. Especially is this the case with goods that contain quite a percentage of cotton. It is always best to dry cloth of this nature as soon as possible after the washing has been completed. The gigging is performed after the drying instead of before. The process itself does not differ from the usual gigging process, except that more care should be exercised when it comes in contact with the napping or gigging work.

Dry gigging applies only to low-grade fancies; but as even these goods frequently have some fancy threads with which silk has been twisted to produce certain effects, it becomes necessary to go very slowly and carefully. If the silk is at all disturbed the goods will require an excessive amount of shearing, for silk fiber is the hardest of any to cut. Goods of this class containing silk are encountered less frequently to-day, owing to the increased use of mercerized cotton yarns introduced to imitate the silk effect.

Wet Gigging. The wet gigging process, rarely used nowadays but an understanding of which is necessary, is simply a brushing of face-finished goods with water. On kerseys which are not steamed, but simply "water finished," this method of treatment is most important. The call to-day is for steam-finished goods with a high luster, but as the appearance of goods is regulated by fashion, the return to the dull or water-finished goods is only a question of time.

As before stated, the speck-dyeing process should always

follow the gigging; if goods are to have a dull finish, the wet gigging follows the speck-dyeing.

After the goods come from the washer they are folded out straight and are then taken to the wet gig, Fig. 26. This is simply an up-and-down gig, the bottom cloth roll of which is set in a tank

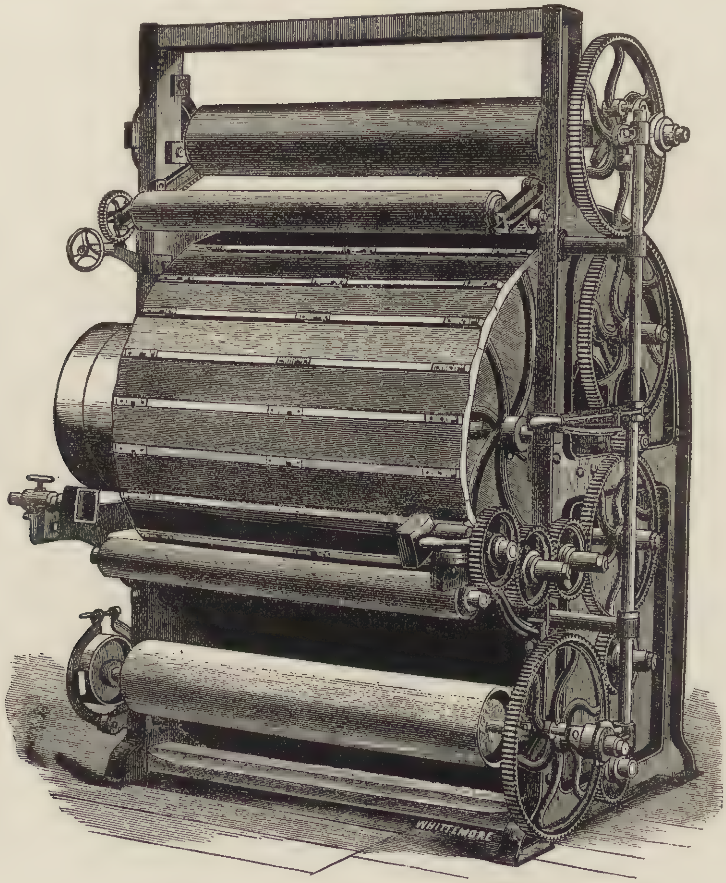


Fig. 26. Wet Gig Showing Winding Attachment.

filled with water. There is also a perforated water pipe, through which the water is introduced to the goods as they pass either to or from the bottom roll. The cylinder is usually clothed with discarded teasel flats, but their use is being discontinued more and more and wood-fiber brushes are used instead. The pieces (one at a

time) are run on the top roll, and are given 4 or 6 runs down and up. After they have run to the top roll for the last time the roll is stopped and the end put around a wooden roll placed in the winding attachment usually found on these machines. The piece is then tightly wound on the wooden roll, the ends being secured by tying two strings around them, and is set on end over night. This produces a very nice finish, although all the luster will disappear in the sponging; the soft feeling of the goods is, however, much improved.

LUSTERING.

Steam Finishing. The elevation, Fig. 27, of the steam-finishing machine shows the general arrangement so that it can be easily understood. By referring to the outline it will be found that the cylinders, upon which the cloth is wound for the steaming operation, are perforated to admit the steam. This is introduced into the cylinder, and finds its way out and through the cloth. As the diameter of these cylinders is about 18 inches, thus taking more than a yard and a half of cloth to go around, several pieces can be wound on them and steamed at the same time. Generally four heavy-weight pieces or six light pieces are enough for one operation.

It is a well-known fact that steam will seek an outlet wherever it meets with the least resistance, therefore if the least resistance is through the cloth, the whole benefit of the steam will be obtained, and the process concluded in a reasonably short time. If, however, the steam finds an outlet at the sides instead of going through the cloth, the whole process will be extended in point of time, and will be generally unsatisfactory. The duration of the steaming is always figured from the time it makes its appearance all over the outside of the goods in an even manner, and not before, so that uneven steaming may be prevented.

The width of the perforated portion of the cylinders has much to do with the character of the work, and consequently must be taken into account. If the cylinder is loaded with four pieces, the outside fold of cloth will be about 6 inches from the outside of the cylinder; or in other words, the thickness of the cloth upon the cylinder will be 6 inches. The goods, with sel-

vedges, usually average from 57 to 58 inches in width, so that when the perforations come to within an inch or two of the edge of the goods it is no more than can be expected to see the steam

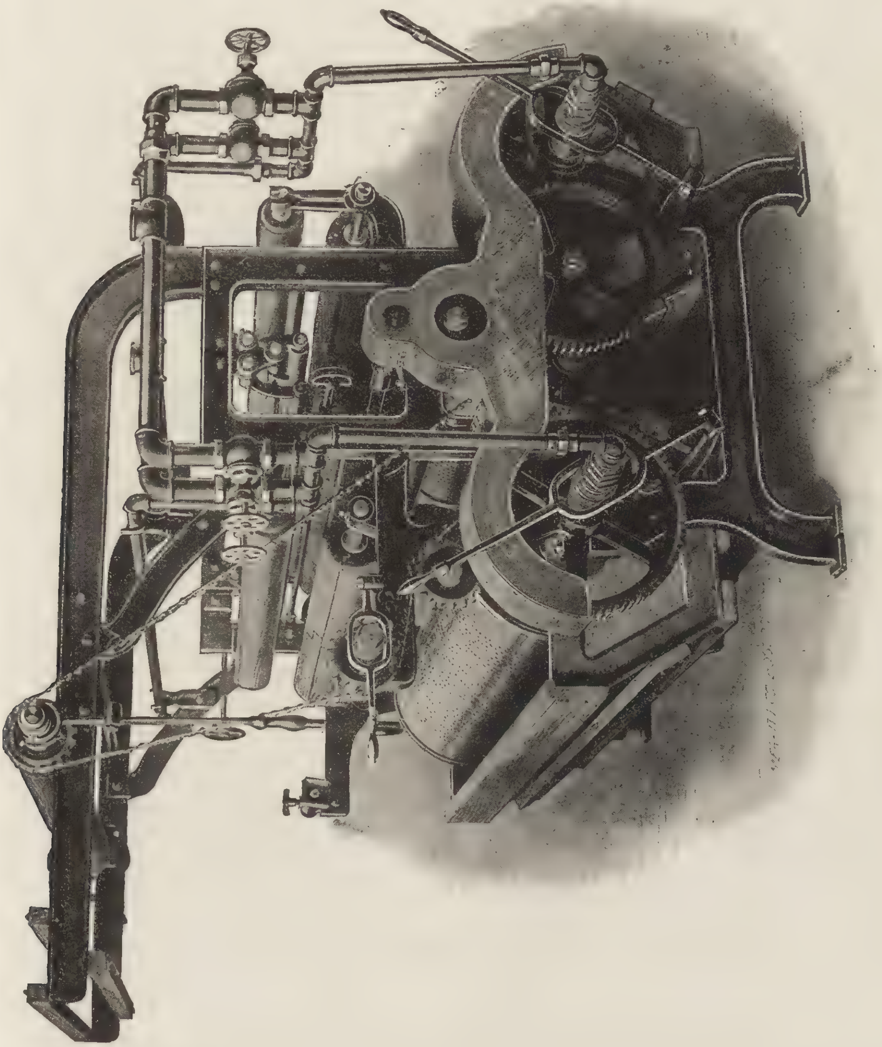


Fig. 27. Steam Finishing Machine

blowing out at the sides long before it will have passed through the cloth. Therefore the perforations of the cylinder should be no nearer the edge of the goods than the distance from the cylin-

der to the outside fold of the cloth ; this being 6 inches for each side, makes 12 inches in all. The perforations should be in this case 45 to 46 inches in width, or $22\frac{1}{2}$ to 23 inches on each side of the center of the cylinder. Fill the surplus perforations by driving into them wooden shoe-pegs. Smooth the tops so as to leave no unevenness, and the steam and water will swell the part inside, thus making the whole as secure as if there had been no perforations. If at any time a wider set of perforations is needed, they can be driven in with little difficulty, and the holes opened again.

If these simple precautions are observed there will be no trouble with the steaming, more goods will be taken off in a day, and those that are taken off will be found well and evenly steamed. Care should be taken to have the goods run exactly in the middle, so as to have the distance between the perforations and the edge of the cloth equal on both sides.

The cylinder, if used as it comes from the shop, will cause the marks of the perforations to show on the first few layers of cloth, and therefore should be well covered with several thicknesses of burlap. On top of this several layers of an open cotton, preferably cheese cloth if it can be obtained wide enough, should be wound. Neither the burlap nor the cotton cloth should have seams, for they are likely to mark the goods. This covering must be put on smoothly and tightly, and some stout twine should be wound tightly around it, starting from the point where the edge of the cloth will come and winding tightly to the head of the cylinder and back again, so that everything is properly secured. Now take a sharp knife, run it under the last fold of the cotton cloth on the edge of the twine, and cut the last layer back for about 18 inches. This is done on both sides, and the flap thus made serves to hold the leader or apron, which is sewn to the end of the cloth. By laying the end of the apron under this flap the apron will be held securely, rendering the sewing unnecessary ; when winding off, the cloth will easily slip from under without making it necessary to stop to undo it.

Operation. The goods which are ready for the steaming are placed evenly on a truck and the several ends nicely sewn together. The opposite condition is now encountered in making the seam. The ends are usually left on the back, so as to have the face

smooth, but here the ends are left on the face, so as to leave the back smooth. This is essential, for when the cloth is wound on the cylinder the face lies against the back; if the seam is made with the ends on the back about a yard and a half or so from the end of the piece, the impress of these ends is left on the face and is next to impossible to remove. Should this mistake occur, an allowance would have to be made or a remnant cut off; but when the seam is made so that the ends are on the face, the imprint will be on the back, where it does no harm. These little things should be remembered, for without taking them into account it is impossible to obtain a perfectly finished piece of the goods.

Back Cylinder. The pieces are now run on to the loading drum or roll, being first drawn through the tension bars, and here at the beginning be careful to have the pieces in the right place. They should be guided evenly to the drum and be as smooth and even as possible. After the drum is loaded, the end of the apron, one of which is sewn to each end of the goods, is brought down under the guide roll at the front cylinder and thence over the two contact rolls, from here around guide rolls, under the back stretch roll, and is then placed smoothly upon the back cylinder with the flap placed over it: See dotted line in Fig. 28. The aprons should be long enough to go the whole distance from the first guide roll to the cylinder and once around this. Turn the back cylinder around once by hand so as to make sure that everything is right and that the apron is held tightly; let the application rolls down so that the brush will strike the goods moderately, and after applying the tension on the loading roll start up the machine; then put the back cylinder into gear and wind the goods up in a tight smooth roll.

It will now be seen why care is necessary in loading the drum, for if it is done properly there will be no further work; but if done unevenly it will be very difficult to make the goods lie well, and their being under tension does not help matters.

Avoid touching the face of the goods between the brush and the cylinder on which the goods are wound, for finger-marks will show after the goods are finished. Wool fibers are laid wet and are dried in that position, consequently no amount of dry work will change them. When the goods are wet out a second time defects may be remedied, but after the wool fiber has been exposed to the

action of the steam which it receives in this process, no amount of work, wet or dry, will entirely bring it back to the proper position.

The aprons used should not only be of the length indicated, but should be wide enough to project about 12 or 18 inches on each side of the goods. When the goods have been wound nicely on the cylinder, the machine is stopped and the ends of the apron securely tied on each side of the goods, so as to form a bag by which the cloth is covered. A strip of burlap about 4 inches wide is then wound around the piece from one end to the other, and secured. This need not be wound on very tightly, but should be well secured. By this arrangement the ends of the apron are prevented from flapping with the action of the steam.

The cylinder is now set in motion again and the water valve opened to introduce water into the cylinder, until it appears evenly on the outside of the goods ; the valve is then shut and the steam valve carefully opened. As soon as the steam valve is opened the exhaust valve at the end of the cylinder and below the journal is opened to let out the water. When the steam comes through this, the exhaust valve is shut and the steam valve is opened wider. When the steam begins to come through the cloth, open the valve entirely; and as soon as it comes through the cloth at all points make a note of the time, for from this moment the steaming process is figured. Usually about ten minutes are allowed, but on low grade stock it is not advisable to give more than two or three minutes. After the steam has been on the prescribed length of time, which is governed by the finish required, as well as by the texture of the goods, it is turned off, and in a few minutes the water is turned on. The cylinder is kept in motion all the time. The water should run evenly through the goods, and under no circumstances be turned off until they are properly cooled.

Front Cylinder. When the cooling is finished turn off the water and stop the cylinder, untie all the coverings, and bring the apron forward to the front cylinder in the same way in which this was accomplished in threading for the back cylinder; that is, bring it under the guide roll, up to and over the application rolls, then around guide rolls, under the stretch roll, to the cylinder: See black line in Fig. 28. Here the same proceeding as on the back cylinder takes place. The tension should be put on the back

cylinder; the front cylinder is then started and the goods wound on. They receive on this cylinder exactly the same treatment as at first; the end, however, which was on the outside during the first steaming is now next to the cylinder, thus giving both ends the same treatment. When cold the goods may be wound on wooden

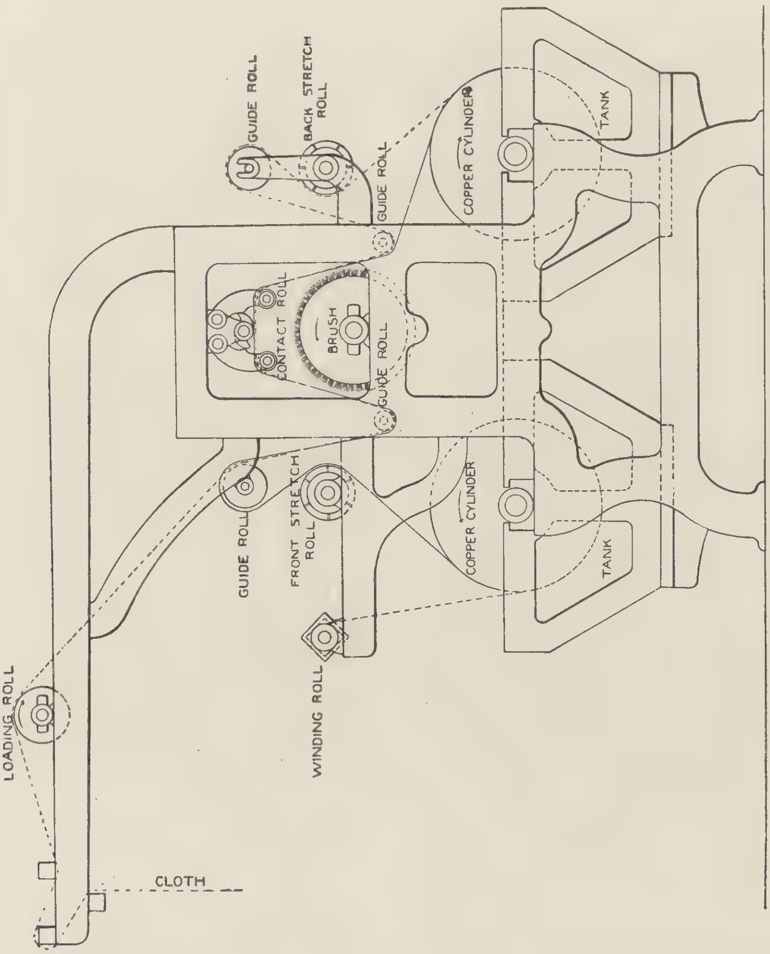


Fig. 28. Sectional View of Steam Finishing Machine.

rolls and stood on end, or pulled off onto a truck or the loading drum, where they remain until they pass to the next process.

Steam Gig. The simplicity of steaming as practiced to-day largely reduces the possibility of its unsuccessful performance; but with some of the older and more complicated methods there

is more opportunity for poor work. The steam gig, Fig. 29, which is practically an up-and-down gig, with the top and bottom rolls made of perforated copper, is very similar to the steaming machine in operation. The goods are run onto the top roll, from there under tension to the bottom roll on which they are well wrapped and secured. The steaming and cooling is practically the same

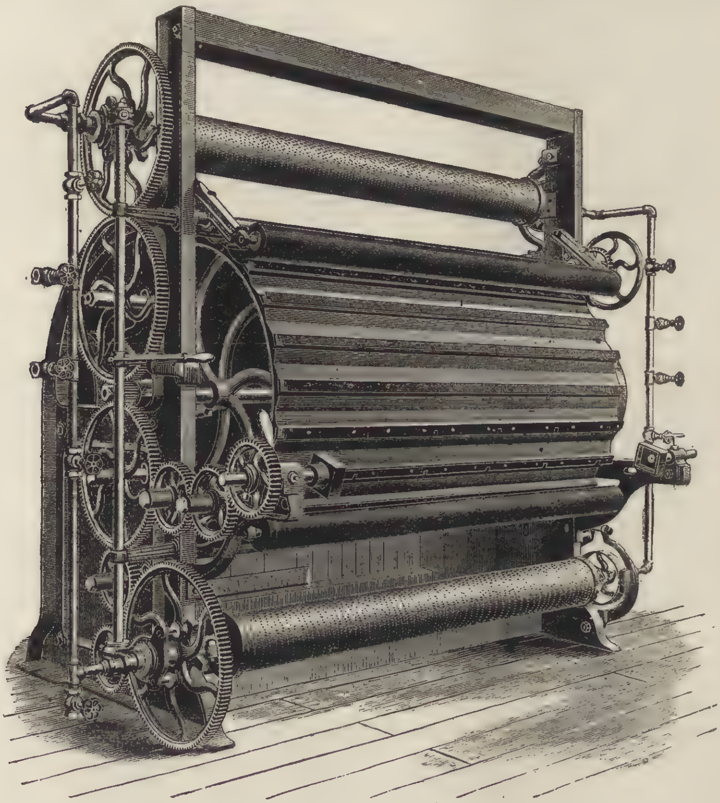


Fig. 29. Steam Gig.

as already described. The goods also receive a second steaming on the top roll. The cylinder acts as a brush, and is, or should be, clothed with wood-fiber brushes. The principal difference between the two machines is in the amount of cloth that can be treated at one time. On account of the size of the rolls one piece of heavy-weight goods, or at most two pieces of light-weight goods, is all that can be steamed at one operation. Finishers

often crowd more goods on to this machine than it is intended to handle, but such attempts generally result in failure.

Boiling Process. Before closing the description of the steaming process, the primitive way of doing the work merits a few words. When no steaming machinery is at hand the work must be accomplished by the old method,— that of boiling. This is the foundation of all the steaming processes so far invented. The finish obtained by this means is the most lasting of any, no matter how produced.

The goods when properly prepared by gigging and cropping are sent to the wet gig and receive a thorough wet gigging, about six runs up and down. The piece is then wound on a wooden roll under moderate tension, and is securely wrapped, the ends being tied. It is placed in a tank, where racks are provided so that each piece or roll is isolated, thus not touching anything. After as many pieces as the tank will hold have been placed in position, it is filled with water and the steam is turned on. The water is kept at a moderate boil for about six hours, the heat permeating the pieces slowly and evenly. This slow boiling process sets the finish, and makes it possible to produce a more lasting finish than by any of the later methods since adopted, but on account of the time required has been abandoned largely in favor of the latest labor and time-saving machines.

After boiling, the hot water is drawn off and the tank is filled with cold water, which is also drawn off after about an hour. The pieces are then taken to the wet gig for six more runs. This time they are wound on the bottom roll; from there they are taken to the wooden roll, thus making the other end the inner one during the process. This boiling is repeated until the desired finish is obtained.

CARBONIZATION.

Process. The carbonizing process is used for the removal of burrs and all vegetable matter found in the goods, which cannot be removed on account of the expense, or which it is useless to try to cover with speck dye. The nature of the process excludes all goods containing cotton; for being a vegetable substance, it would be consumed as readily as any other. The carbonizing of piece goods is accomplished by the use of sulphuric acid or oil of vitriol.

The goods are immersed in an acid-proof tank, generally lead-lined or wooden, about 10 or 12 feet long, $4\frac{1}{2}$ feet deep and 6 feet wide. A pair of heavy wooden squeeze-rolls are placed on one end of the tank; the extractor should be near at hand. The tank is filled with a sulphuric acid bath of 5° Baumé. The pieces are then entered and kept well under the liquor for about twenty minutes, one end of each, or one end of the string, being secured near the rolls. They are then passed through the squeeze-rolls in such a way that the liquor squeezed out may be returned to the tank. From these rolls they pass at once to the extractor, with as little handling as possible.

After the cloth has been extracted it is spread on poles in the dry room, or run through the tenter and dried with excessive heat. The temperature should not fall below 180° F., otherwise the vegetable matter impregnated with the acid will not char. After this baking is completed, which may be determined by trying the pieces to see if the burrs have been well burned, the goods receive one run on an up-and-down gig. The burned vegetable matter is thus pulverized, and provided the process has been thoroughly performed, passes off in a cloud of dust.

Neutralizing. The acid remaining in the goods after carbonizing should be neutralized by washing the pieces for about twenty-five minutes with water containing 2 or 3 per cent of sal soda. They are then rinsed for fifteen or twenty minutes. If at the end of this time the cloth is still slippery to the touch the acid has not been competely neutralized, the washing should be repeated. On piece-dyed goods where acid colors are used, the neutralizing process is not necessary; the cloth, after beating on the gig, is at once sent to the dye-house.

SHRINKAGE TABLES.

Explanation. In the following tables the first column represents the weight of the goods per yard as they come from the loom, the figures representing ounces and tenths of ounces. At the top of each of the other columns is given the estimated per cent of loss sustained by the goods in the process of finishing. On a line with the weight of goods, as given in the first column, are found two lines of figures; the upper one in Roman type and the lower in italics. The upper figures represent the finished weight required and the italics show the amount the goods must be shrunk per yard in order to obtain the finished weight. The italics represent inches and tenths of inches.

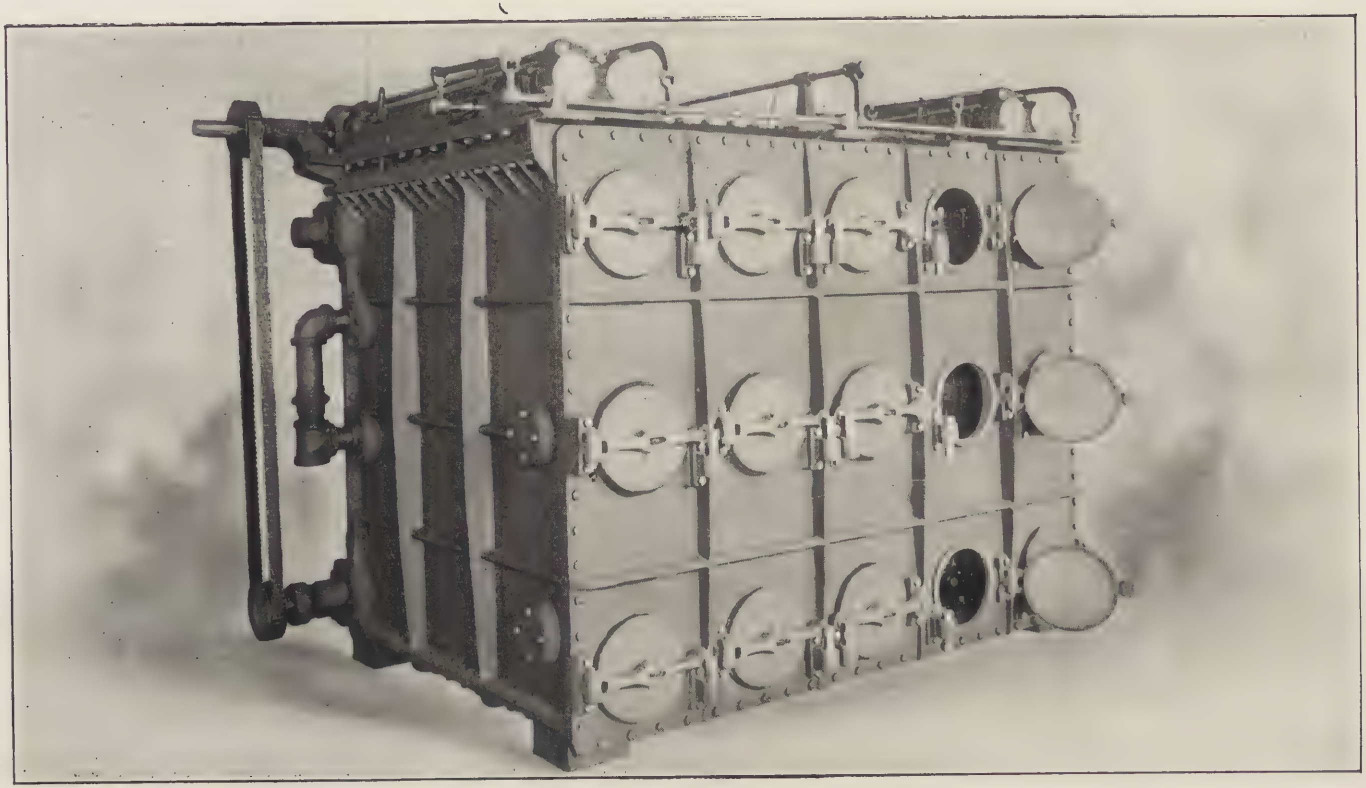
To use the tables it is necessary to estimate the percentage of loss, then look in the column representing such percentage as indicated at the top and follow down this column until in line with the weight from loom in the first column, when the necessary amount of shrinkage per yard will be found under the figures giving the finished weight wanted.

For example, assume that it is necessary to find the shrinkage for a piece of cloth weighing 18.5 ounces from the loom which is to finish 19 ounces, and which it is estimated loses 25 per cent in finishing. The method would be as follows: Follow the 25 per cent loss column until in line with the figures 18.5 in the first column. Under the figures 19 will be found the figures 9.7 in italics, which means that each yard must be shrunk 9.7 inches in length in order to give a finished weight of 19 ounces.

SHRINKAGE.

ESTIMATED PER CENT OF LOSS.

Weight in oz. per yard from loom.	10 per cent.	12½ per cent.	15 per cent.	17½ per cent.
7	8 7.7	8 8.4	8 9.2	8 10.0
7.5	8 5.6	8 6.5	8 7.3	8 8.1
8	8 9 3.6 7.2	8 9 4.5 8.0	8 9 5.4 8.8	8 9 6.3 9.6
8.5	8 9 1.6 5.4	8 9 2.5 6.3	8 9 3.5 7.1	8 9 4.4 8.0
9	9 10 3.6 6.9	8 9 10 0.5 4.5 7.6	8 9 10 1.6 5.4 8.7	8 9 10 2.5 6.3 9.4
9.5	9 10 1.8 5.4	9 10 2.8 6.5	9 10 3.7 6.9	8 9 10 0.6 4.7 7.6
10	10 11 3.6 6.6	9 10 11 1.0 4.7 7.5	9 10 11 2.0 5.4 8.2	9 10 11 3.0 6.5 9.2
10.5	10 11 2.2 5.2	10 11 2.6 5.9	9 10 11 0.3 3.6 6.9	9 10 11 1.3 4.7 7.9
11	10 11 12 0.4 3.6 6.3	10 11 12 1.5 4.6 7.2	10 11 12 2.2 5.6 8.1	10 11 12 3.4 6.6 9.0
11.5	11 12 2.3 4.9	11 12 3.3 5.8	10 11 12 0.4 4.1 6.7	10 11 12 1.8 5.1 7.6
12	11 12 13 0.7 3.6 6.1	11 12 13 1.6 4.5 7.0	11 12 13 2.6 5.4 7.8	10 11 12 13 0.4 3.6 6.3 8.6
12.5	12 13 2.2 4.8	11 12 13 0.3 3.1 5.7	11 12 13 1.3 4.2 6.7	11 12 13 2.3 5.1 7.5
13	12 13 14 0.9 3.6 5.9	12 13 14 1.8 4.5 6.6	12 13 14 3.0 5.6 7.7	11 12 13 14 1.0 3.9 6.4 8.5
13.5	13 14 2.3 4.7	12 13 14 0.4 3.3 5.6	12 13 14 1.6 4.3 6.5	12 13 14 2.7 5.2 7.5
14	13 14 15 1.1 3.6 5.8	13 14 15 2.2 4.6 6.7	12 13 14 15 0.3 3.1 5.4 7.5	12 13 14 15 1.5 4.0 6.4 8.3
14.5	14 15 2.4 4.7	13 14 15 1.1 3.5 5.7	13 14 15 1.8 4.4 6.5	12 13 14 15 0.3 2.8 5.2 7.3
15	14 15 16 1.3 3.6 5.6	14 15 16 2.5 4.6 6.5	13 14 15 16 0.6 3.4 5.5 7.2	13 14 15 16 1.7 4.0 6.3 8.0
15.5	14 15 16 0.3 2.5 4.6	14 15 16 1.3 3.5 5.5	14 15 16 2.2 4.5 6.3	13 14 15 16 0.6 3.0 5.3 7.0
16	15 16 17 1.4 3.6 6.4	14 15 16 17 0.3 2.4 4.5 7.3	14 15 16 17 1.0 3.4 5.4 8.1	14 15 16 17 2.0 4.3 6.0 8.9
16.5	15 16 17 0.3 2.6 5.5	15 16 17 1.3 3.5 6.4	15 16 17 2.4 4.4 7.2	14 15 16 17 1.0 3.3 5.3 8.0
17	16 17 18 1.6 4.5 5.4	15 16 17 18 0.2 2.5 5.5 6.2	15 16 17 18 1.4 3.5 6.3 7.1	15 16 17 18 2.4 4.5 7.1 8.0
17.5	16 17 18 0.6 3.6 4.5	16 17 18 1.5 4.5 5.3	15 16 17 18 0.3 2.5 5.4 6.3	15 16 17 18 1.4 3.5 6.3 7.1
18	17 18 19 2.6 3.6 5.3	16 17 18 19 0.5 3.6 4.4 6.0	16 17 18 19 1.6 4.5 5.4 7.0	15 16 17 18 19 0.4 2.6 5.4 6.3 7.9
18.5	17 18 19 1.7 2.7 4.3	17 18 19 2.7 3.5 5.2	16 17 18 19 0.7 3.6 4.6 6.2	16 17 18 19 1.8 4.4 5.6 7.1
19	17 18 19 20 0.8 1.8 3.4 5.3	17 18 19 20 1.7 2.7 4.5 6.1	17 18 19 20 2.7 3.7 5.4 7.0	16 17 18 19 20 1.0 3.7 4.6 6.3 7.8
19.5	18 19 20 0.9 2.6 4.5	17 18 19 20 0.8 1.8 3.7 5.3	17 18 19 20 1.8 2.9 4.6 6.3	17 18 19 20 2.8 3.8 5.5 7.0
20	19 20 21 1.9 3.6 5.1	18 19 20 21 1.0 2.9 4.6 6.0	17 18 19 20 21 0.9 2.0 3.8 5.4 6.9	17 18 19 20 21 1.9 3.0 4.7 6.3 7.7
20.5	19 20 21 1.0 2.8 4.4	19 20 21 2.0 3.8 5.3	18 19 20 21 1.1 3.0 4.6 6.2	17 18 19 20 21 1.0 2.2 3.9 5.5 7.0
21	19 20 21 22 0.2 2.0 3.6 5.1	19 20 21 22 1.1 3.0 4.4 6.0	18 19 20 21 22 0.3 2.2 3.9 5.4 6.8	18 19 20 21 22 1.3 3.2 4.8 6.3 7.5
21.5	20 21 22 1.2 2.9 4.3	19 20 21 22 0.3 2.2 3.8 5.2	19 20 21 22 1.4 3.1 4.7 6.1	18 19 20 21 22 0.3 2.4 4.0 5.6 6.9
22	20 21 22 23 0.4 2.1 3.6 5.1	20 21 22 23 1.4 3.0 4.5 5.9	19 20 21 22 23 0.6 2.5 4.0 5.4 6.7	19 20 21 22 23 1.6 3.3 4.9 6.3 7.6
22.5	21 22 23 1.3 2.8 4.3	20 21 22 23 0.6 2.3 3.8 5.2	20 21 22 23 1.7 3.3 4.7 6.1	19 20 21 22 23 0.8 2.5 4.2 5.6 7.0



VACUUM DRYER FOR DRYING CLOTH FULL WIDTH
Vacuum Process Co.

SHRINKAGE.

ESTIMATED PER CENT OF LOSS.

Weight in oz. per yard from loom.	20 per cent.	22½ per cent.	25 per cent.
7	8 *10.8*	8 *11.6*	8 *12.4*
7.5	8 *9.0*	8 *9.9*	8 *10.7*
8	8 9 *7.2 10.4*	8 9 *8.1 11.2*	8 9 *9.0 12.0*
8.5	8 9 *5.4 8.8*	8 9 *6.3 9.7*	8 9 *7.3 10.5*
9	8 9 10 *3.6 7.2 10.1*	8 9 10 *7.5 8.1 10.8*	8 9 10 *5.6 9.0 11.6*
9.5	8 9 10 *1.8 5.6 8.7*	8 9 10 *2.7 6.6 9.4*	8 9 10 *3.9 7.5 10.5*
10	9 10 11 *4.0 7.2 9.9*	8 9 10 11 *0.9 5.0 7.6 10.5*	8 9 10 11 *2.2 6.0 9.0 11.5*
10 5	9 10 11 *2.4 5.8 8.5*	9 10 11 *3.5 6.5 9.3*	8 9 10 11 *0.5 4.5 7.6 10.3*
11	9 10 11 12 *0.8 4.4 7.2 9.6*	9 10 11 12 *1.9 5.4 8.2 10.5*	9 10 11 12 *3.0 6.5 9.2 11.4*
11.5	10 11 12 *2.9 5.9 8.4*	9 10 11 12 *0.3 4.0 6.9 9.3*	9 10 11 12 *1.5 5.1 7.9 10.2*
12	10 11 12 13 *1.5 4.6 7.2 9.4*	10 11 12 13 *2.6 5.6 8.1 10.3*	10 11 12 13 *3.6 6.6 9.0 11.1*
12.5	11 12 13 *3.3 6.0 8.3*	10 11 12 13 *1.1 4.4 7.0 9.3*	10 11 12 13 *2.2 5.4 7.8 10.0*
13	11 12 13 14 *2.0 4.8 7.2 9.1*	11 12 13 14 *3.3 5.9 8 3 10.3*	10 11 12 13 14 *0.8 4.3 6.6 8.9 10.8*
13.5	11 12 13 14 *0.7 3.6 6.1 8.1*	11 12 13 14 *2.0 4.7 7.2 9.3*	11 12 13 14 *3.0 5.6 7.9 9.9*
14	12 13 14 15 *2.4 5.0 7.2 9.2*	11 12 13 14 15 *0.7 3.6 6.1 8.2 9.8*	11 12 13 14 15 *1.7 4.5 7.0 9.0 10.8*
14.5	12 13 14 15 *1.2 3.9 6.2 8.2*	12 13 14 15 *2.4 5.0 7.4 8.8*	11 12 13 14 15 *0.4 3.4 6.0 8.1 9.9*
15	13 14 15 16 *2.8 5.2 7.2 9.0*	12 13 14 15 16 *1.2 3.9 6.7 7.9 9.8*	12 13 14 15 16 *2.4 5.0 7.2 9.0 10.7*
15.5	13 14 15 16 *1.7 4.1 6.2 8.1*	13 14 15 16 *2.8 5.4 6.9 8.9*	12 13 14 15 16 *1.2 3.9 6.5 8.1 9.8*
16	13 14 15 16 17 *0.6 3.0 5.3 7.2 9.7*	13 14 15 16 17 *1.7 4.1 6.0 8.0 10.7*	13 14 15 16 17 *2.8 5.9 7.2 9.0 11.4*
16.5	14 15 16 17 *2 0 4.3 6.3 8.9*	13 14 15 16 17 *0.6 3.1 5.1 7 0 9.8*	13 14 15 16 17 *1.7 4.5 6.3 8.2 10.7*
17	14 15 16 17 18 *1.0 3.4 5.4 8.0 8.8*	14 15 16 17 18 *2.0 4.2 6.0 8.9 9.7*	13 14 15 16 17 18 *0.6 3.1 5.4 7.3 9.8 10.5*
17.5	15 16 17 18 *2.4 4.5 7.2 8.0*	14 15 16 17 18 *1.0 3.2 5.3 8.0 8.9*	14 15 16 17 18 *2.2 4.5 6.5 9.0 9.8*
18	15 16 17 18 19 *1.4 3.6 6.6 7.4 8.7*	15 16 17 18 19 *2.3 4.6 7.3 8.1 9.6*	14 15 16 17 18 19 *1.3 3.6 5.6 8.2 9.0 10.4*
18.5	15 16 17 18 19 *0.4 2.7 5.9 6.4 8.0*	15 16 17 18 19 *1.4 3.7 6.5 7.3 8.8*	14 15 16 17 18 19 *0.3 2.7 4.8 7.4 8.3 9.7*
19	16 17 18 19 20 *1.8 4 8 5.6 7.2 8.7*	15 16 17 18 19 20 *0.5 2.9 5.7 6.5 8.0 9.5*	15 16 17 18 19 20 *1.8 4.0 6.6 7.5 9.0 10.4*
19.5	16 17 18 19 20 *0.9 3.8 4.8 6.4 8 0*	16 17 18 19 20 *1.9 4.8 5.8 7 3 8.8*	15 16 17 18 19 20 *0.9 3.0 5.8 6.8 8.3 9.7*
20	17 18 19 20 21 *2.9 4.0 5.7 7.2 8.6*	16 17 18 19 20 21 *0.9 3 9 5.0 6.6 8.1 9.4*	16 17 18 19 20 21 *2.0 4.9 6.0 7.6 9.0 10.3*
20.5	17 18 19 20 21 *2.0 3.2 4.9 6.5 7.9*	17 18 19 20 21 *3.0 4.2 5.6 7.4 8.8*	16 17 18 19 20 21 *1.3 4.0 5.3 6.9 8.3 9.6*
21	17 18 19 20 21 22 *1.4 2.4 4.2 5.8 7.2 8.5*	17 18 19 20 21 22 *2.2 3.4 4.6 6.7 8.1 9.3*	17 18 19 20 21 22 *3.3 4.5 6.2 7.7 9.0 10.2*
21.5	17 18 19 20 21 22 *0.7 1.6 3.4 5.1 6.5 7.8*	17 18 19 20 21 22 *1.3 2.6 4.1 6.0 7.4 8.7*	17 18 19 20 21 22 *2.6 3.8 5.4 7.0 8.3 9.6*
22	18 19 20 21 22 23 *0.8 2.7 4.4 5.8 7.2 8.5*	17 18 19 20 21 22 23 *0.6 1.9 3.7 5.3 6.8 8.1 9.2*	17 18 19 20 21 22 23 *1.8 3.0 4.7 6.3 7.7 9.0 10.0*
22.5	19 20 21 22 23 *1.9 3.7 5.2 6.4 7.8*	18 19 20 21 22 23 *1.1 2.7 4.6 6.2 7.4 8.6*	17 18 19 20 21 22 23 *1 0 2.3 4.0 5.5 6.4 8.4 9.5*

SHRINKAGE.

ESTIMATED PER CENT OF LOSS.

Weight in oz. per yard from loom.	10 per cent.	12½ per cent.	15 per cent.	17½ per cent.
23	21 22 23 24 *0.5 2.0 3.6 5.0*	21 22 23 24 *1.5 3.0 4.5 5.9*	20 21 22 23 24 *0.9 2.5 4.0 5 4 6.7*	20 21 22 23 24 *1.8 3.5 5.0 6.3 7.6*
23.5	22 23 24 *1.3 2.9 4.3*	21 22 23 24 *0.7 2.3 3.9 5.2*	21 22 23 24 *1.8 3.3 4.8 6.0*	20 21 22 23 24 *1.0 2.8 4 3 5.7 7 2*
24	22 23 24 25 *0 7 2.2 3.6 4.9*	22 23 24 25 *1.7 3.2 4.6 5.8*	21 22 23 24 25 *1.1 2.6 4.1 5 4 6.6*	20 21 22 23 24 25 *0.3 2.1 3.6 5 1 6.2 7.5*
24.5	23 24 25 *1 5 2.9 4.3*	22 23 24 25 *1 0 2.5 4.0 5 2*	21 22 23 24 25 *0.3 1 9 3.4 4.8 6.0*	21 22 23 24 25 *1.4 2 9 4 4 5.7 6.9*
25	23 24 25 26 *0.8 2.3 3 6 4.8*	22 23 24 25 26 *0.3 1.8 3.4 4.5 5.7*	22 23 24 25 26 *1.2 2 7 4.2 5 4 6.6*	21 22 23 24 25 26 *0.7 2.2 3 7 5 1 6.3 7.5*
25.5	24 25 26 *1.6 3.0 4 2*	23 24 25 26 *1.1 2.7 3.9 5.1*	22 23 24 25 26 *0.5 2.1 3 5 4.8 6.0*	22 23 24 25 26 *1.6 3 1 4 6 5 7 6.9*
26	24 25 26 27 *0.9 2 3 3 6 4 8*	23 24 25 26 27 *0.4 2.0 3.3 4.5 5.7*	23 24 25 26 27 *1.4 2.9 4.2 5.4 6.5*	22 23 24 25 26 27 *1.0 2.5 3.9 5.1 6.3 7 2*
26.5	25 26 27 *1.6 3.0 4 2*	24 25 26 27 *1 5 2.6 3.9 5.1*	23 24 25 26 27 *0 7 2.3 3 6 4.8 5.9*	22 23 24 25 26 27 *0.3 1.8 3 3 4.5 5.7 6.7*
27	25 26 27 28 *1.0 2.4 3 6 4.8*	24 25 26 27 28 *0.9 2 0 3.3 4.5 5.6*	24 25 26 27 28 *1.6 3.0 4.2 5 4 6.5*	23 24 25 26 27 28 *1.1 2.6 4.0 5.1 6.2 7.4*
27.5	25 26 27 28 *0.4 1.8 3.0 4.2*	25 26 27 28 *1.3 2.7 3.9 5.1*	24 25 26 27 28 *0.9 2 3 3.6 4.9 6.0*	23 24 25 26 27 28 *0.5 1.9 3.2 4.5 5.6 6.9*
28	26 27 28 29 *1.1 2.4 3 6 4.7*	25 26 27 28 29 *0.7 2.1 3.3 4.5 5.6*	25 26 27 28 29 *1.7 3.1 4.3 5.4 6 5*	24 25 26 27 28 29 *1.3 2 3 4.0 5.0 6.3 7.2*
28.5	26 27 28 29 *0.4 1 8 3 0 4 1*	26 27 28 29 *1.4 2 7 3.9 5.0*	25 26 27 28 29 *1.1 2 5 3 7 4.8 6 0*	24 25 26 27 28 29 *0.7 1.8 3.4 4 5 5.8 6.7*
29	27 28 29 30 *1 2 2.4 3.6 4.7*	26 27 28 29 30 *0.8 2.1 3.4 4.5 5.5*	25 26 27 28 29 30 *0.5 1.9 3.1 4.3 5.4 6.4*	25 26 27 28 29 30 *1.2 2.9 4.0 5.3 6.2 7.3*
29.5	27 28 29 30 *0.6 1.9 3.0 4.2*	27 28 29 30 *1 5 2.8 4.0 5.0*	26 27 28 29 30 *1.3 2 5 3.7 4.9 5.9*	25 26 27 28 29 30 *0 4 2.3 3.5 4.7 5.7 6.8*
30	28 29 30 *1 3 2.5 3.6*	27 28 29 30 *0.9 2.3 3.5 4.5*	26 27 28 29 30 *0.7 2.0 3.2 4.4 5.4*	26 27 28 29 30 *1.8 3 0 4 2 5.2 6 3*
30.5	28 29 30 *0.7 1.9 3.1*	28 29 30 *1.7 2 9 4.0*	27 28 29 30 *1.5 2.7 3.8 4.9*	26 27 28 29 30 *1.2 2.5 3 7 4.7 5.8*
31	29 30 *1 4 2.5*	28 29 30 *1.1 2.4 3 5*	27 28 29 30 *0.9 2.1 3.3 4 4*	26 27 28 29 30 *0.6 1.6 3.1 4 2 5.3*
31.5	29 30 *0.8 2.0*	28 29 30 *0.6 1.8 3.0*	28 29 30 *1.6 2 8 3 9*	27 28 29 30 *1.1 2.6 3.7 4.8*
32	30 *1 5*	29 30 *1.2 2.5*	28 29 30 *1 0 2 2 3 4*	27 28 29 30 *0 6 2.0 3 2 4 3*
32.5	30 *1.0*	29 30 *0.7 2.0*	28 29 30 *0 4 1.7 2.9*	28 29 30 *1.5 2.6 3.8*
33	30 *0.4*	30 *1.4*	29 30 *1.2 2.4*	28 29 30 *1.0 2.1 3 3*
33.5		30 *0.9*	29 30 *0.7 1 9*	28 29 30 *0.5 1.6 2.8*
34			30 *1.3*	29 30 *1.1 2 3*
34 5			30 *0.8*	29 30 *0.6 1.8*
35				30 *1.4*
35.5				30 *0.9*
36				
36 5				
37				
37.5				
38				
38.5				
39				

SHRINKAGE.

ESTIMATED PER CENT OF LOSS.

Weight in oz. per yard from loom.	20 per cent.	22½ per cent.	25 per cent.
23	19 20 21 22 23 24 *1.2 2.9 4.5 5.9 7.2 8.4*	18 19 20 21 22 23 24 *0.4 2.0 4.0 5.5 6.9 8.1 9.3*	18 19 20 21 22 23 24 *1.5 3.3 4.9 5.8 7.8 9.0 10.1*
23.5	19 20 21 22 23 24 *0.4 2.2 3.8 5.3 6.6 7.8*	19 20 21 22 23 24 *1.4 3.3 4.8 6.2 7.6 8.7*	18 19 20 21 22 23 24 *0.8 2.6 4.2 5.1 7.1 8.5 9.6*
24	20 21 22 23 24 25 *1.5 3.1 4.6 5.3 7.2 8.4*	19 20 21 22 23 24 25 *0.8 2.6 4.1 5.6 7.0 8.1 9.3*	19 20 21 22 23 24 25 *1.9 3.6 4.5 6.5 7.9 9.0 10.2*
24.5	20 21 22 23 24 25 *0.7 2.4 4.0 4.7 6.6 7.8*	20 21 22 23 24 25 *1.8 3.5 5.0 6.3 7.5 8.7*	19 20 21 22 23 24 25 *1.2 2.9 4.0 5.9 7.3 8.4 9.6*
25	21 22 23 24 25 26 *1.7 3.3 4.1 6.0 7.2 8.3*	20 21 22 23 24 25 26 *1.1 2.8 4.3 5.7 7.0 8.1 9.2*	19 20 21 22 23 24 25 26 *0.5 2.3 3.3 5.3 6.7 7.9 9.0 10.0*
25.5	21 22 23 24 25 26 *1.1 2.6 3.5 5.4 6.6 7.8*	20 21 22 23 24 25 26 *0.3 2.1 3.6 5.1 6.4 7.5 8.7*	20 21 22 23 24 25 26 *1.6 2.6 4.7 6.1 7.3 8.5 9.5*
26	21 22 23 24 25 26 27 *0.6 2.0 2.8 4.8 6.0 7.2 8.0*	21 22 23 24 25 26 27 *1.3 3.0 4.5 5.8 7.0 8.1 9.0*	20 21 22 23 24 25 26 27 *0.9 2.0 4.1 5.5 6.8 7.9 9.0 10.0*
26.5	22 23 24 25 26 27 *1.3 2.2 4.2 5.5 6.6 7.5*	21 22 23 24 25 26 27 *0.6 2.4 3.9 5.2 6.4 7.6 8.5*	21 22 23 24 25 26 27 *1.3 3.5 4.9 6.2 7.3 8.5 9.5*
27	22 23 24 25 26 27 28 *0.7 1.6 3.6 4.9 6.0 7.0 8.2*	22 23 24 25 26 27 28 *1.8 3.3 4.6 5.9 7.0 8.0 9.1*	21 22 23 24 25 26 27 28 *0.6 2.9 4.2 5.7 6.8 8.0 9.0 10.0*
27.5	23 24 25 26 27 28 *1.0 3.0 4.0 5.4 6.5 7.7*	22 23 24 25 26 27 28 *1.2 2.6 4.0 5.2 6.5 7.5 8.6*	22 23 24 25 26 27 28 *2.3 3.7 5.1 6.3 7.5 8.5 9.5*
28	23 24 25 26 27 28 29 *0.4 2.4 3.0 4.8 6.0 7.2 8.0*	22 23 24 25 26 27 28 29 *0.6 2.0 3.5 4.4 6.0 7.0 8.1 8.9*	22 23 24 25 26 27 28 29 *1.6 3.1 4.6 5.8 7.0 8.0 9.0 10.0*
28.5	24 25 26 27 28 29 *1.8 2.4 4.3 5.5 6.7 7.5*	23 24 25 26 27 28 29 *1.5 2.9 3.8 5.4 6.5 7.6 8.5*	22 23 24 25 26 27 28 29 *0.9 2.6 4.1 5.1 6.5 7.5 8.5 9.5*
29	24 25 26 27 28 29 30 *1.2 2.8 3.9 5.0 6.2 7.0 8.2*	23 24 25 26 27 28 29 30 *0.9 2.4 3.2 4.9 6.0 7.1 8.0 9.1*	23 24 25 26 27 28 29 30 *2.0 3.5 4.5 5.9 7.0 8.0 9.0 9.9*
29.5	24 25 26 27 28 29 30 *0.6 1.1 3.3 4.5 5.7 6.5 7.7*	24 25 26 27 28 29 30 *1.8 2.5 4.3 5.5 6.6 7.5 8.6*	23 24 25 26 27 28 29 30 *1.4 3.0 4.0 5.3 6.5 7.5 8.5 9.4*
30	25 26 27 28 29 30 *0.4 2.8 4.0 5.2 6.0 7.2*	24 25 26 27 28 29 30 *1.2 2.0 3.8 5.0 6.1 7.0 8.1*	23 24 25 26 27 28 29 30 *0.8 2.4 3.6 4.8 6.0 7.0 8.0 9.0*
30.5	26 27 28 29 30 *2.2 3.5 4.6 5.5 6.8*	24 25 26 27 28 29 30 *0.6 1.4 3.2 4.5 5.5 6.5 7.6*	24 25 26 27 28 29 30 *1.8 3.0 4.3 5.5 6.5 7.5 8.5*
31	26 27 28 29 30 *1.7 3.0 4.1 5.0 6.3*	25 26 27 28 29 30 *0.8 2.7 4.0 5.0 6.0 7.2*	24 25 26 27 28 29 30 *1.2 2.5 3.8 5.0 6.0 7.0 8.1*
31.5	27 28 29 30 *2.5 3.6 4.5 5.8*	26 27 28 29 30 *2.2 3.5 4.5 5.5 6.7*	24 25 26 27 28 29 30 *0.6 2.0 3.3 4.5 5.5 6.5 7.7*
32	27 28 29 30 *2.0 3.0 4.0 5.3*	26 27 28 29 30 *1.7 3.0 4.0 5.0 6.2*	25 26 27 28 29 30 *1.4 2.8 4.0 5.0 6.0 7.2*
32.5	27 28 29 30 *1.4 2.5 3.5 4.8*	26 27 28 29 30 *1.2 2.5 3.5 4.5 5.7*	25 26 27 28 29 30 *0.8 2.3 3.5 4.5 5.5 6.7*
33	27 28 29 30 *0.8 2.0 3.0 4.3*	26 27 28 29 30 *0.7 2.0 3.0 4.0 5.3*	26 27 28 29 30 *1.7 3.0 4.0 5.0 6.3*
33.5	28 29 30 *1.5 2.5 3.8*	27 28 29 30 *1.5 2.5 3.5 4.8*	26 27 28 29 30 *1.2 2.5 3.5 4.5 5.9*
34	28 29 30 *1.0 2.0 3.4*	27 28 29 30 *1.0 2.0 3.0 4.4*	26 27 28 29 30 *0.7 2.0 3.0 4.1 5.4*
34.5	28 29 30 *0.5 1.5 2.9*	27 28 29 30 *0.5 1.5 2.5 3.9*	27 28 29 30 *1.5 2.5 3.7 4.9*
35	29 30 *1.0 2.4*	28 29 30 *1.0 2.0 3.3*	27 28 29 30 *1.0 2.0 3.2 4.5*
35.5	29 30 *0.5 1.9*	28 29 30 *0.5 1.5 2.9*	27 28 29 30 *0.5 1.5 2.7 4.1*
36	30 *1.5*	29 30 *1.0 2.5*	28 29 30 *1.0 2.2 3.6*
36.5	30 *0.9*	29 30 *0.5 2.0*	28 29 30 *0.5 1.7 3.1*
37		30 *1.5*	29 30 *1.2 2.6*
37.5		30 *0.9*	29 30 *0.7 2.1*
38			30 *1.6*
38.5			30 *1.1*
39			30 *0.6*

FIFTY CELL DRYER RUNNING ON BACK GREYS
Vacuum Process Co.

WOOLEN AND WORSTED FINISHING.

PART II.

DRY FINISHING.

The dry finishing of woolen and worsted goods consists of the following processes: *Drying*, *brushing*, *shearing*, *pressing*, *final inspection*, *measuring*, *rolling*, and *packing*.

DRYING.

Natural Process. The drying process, which is the first operation, is performed in two ways—the *natural* and the *artificial*. When the natural method of drying is employed, the

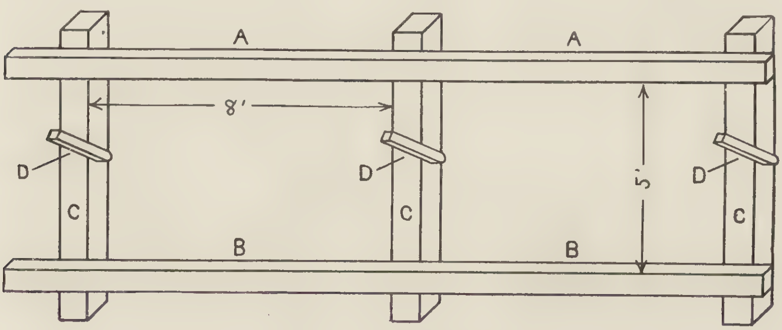


Fig. 30. Tenter Bars.

goods, after being well extracted or squeezed, are stretched on the tenter bars, as previously explained. These tenter bars consist of posts firmly set in the ground about eight feet apart, with cross bars of two-by-four material, the top one of which is rigid and the bottom one movable; the complete framework appearing somewhat as in the illustration, Fig. 30. Hooks or patent clothing, of which Figs. 31 and 32 give a good idea, are fitted to the cross bars, and the posts carry arms which can be let down to hold the

cloth until it is hooked. The piece is stretched by hooking one end to the first post by means of a strip of card clothing, and to the top and bottom bars for four or five hooks from the end; then hooking the other end to the head board (illustrated at Fig. 33) and drawing it out to the required length, where it is held by attaching the head board to one of the posts. The selvedge on one end of the cloth is now fastened at intervals on the top bar and the other selvedge fastened in the same manner to the bottom bar.

Fig. 31. Tenter Hook.

On *gigged goods* it is customary to brush the nap which has become roughened by treatment in this process. On close-finished goods this is not necessary, but must be done in all cases on face goods to remove roughness caused by handling. Wool fibre will remain in the position in which it dries, so that if on napped

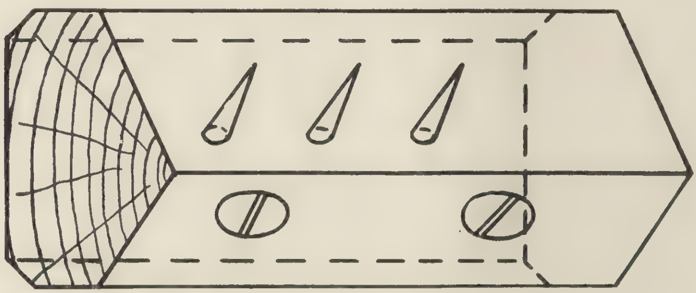


Fig. 32. Tenter Bar Clothing.

goods the nap is roughened and dried rough, no amount of after work will smooth it out. After the goods are dry they are removed from the bars and taken inside to be immediately folded. In doing this every inch of the listing should pass through the folder's hands to make sure that no hooks or pins remain in the goods. The bars being of wood and exposed to the weather will crack and the hooks or pins become loosened, so that in taking the goods off the bars some of the pins may come out, and sticking in the cloth cause damage unless removed.

The above is the natural process of drying which is in use in many places, but on account of the length of time required, uncer-

tainty of weather, and other disadvantages, the substitution of the more positive artificial process is rapidly coming about.

Artificial Process. The more nearly natural conditions can be approximated, the more successful the artificial process of drying will be. These conditions consist chiefly in a generous supply of air to absorb the moisture together with the spreading of the cloth in such a way that the air may have easy access to all parts of it. The idea that heat will expel water is erroneous. The application of heat is effective in drying because of the greater absorptive capacity of heated air as compared with cool air. A certain amount of moisture being always present in the air it is capable of absorbing still more if heated, but unless the air is supplied in sufficient quantities, the heat alone will not dry the goods.

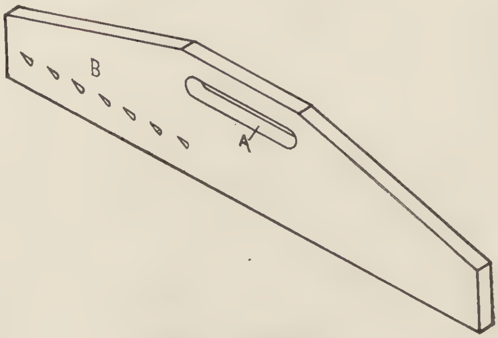


Fig. 33. Headboard.

The following table shows the capacity of absorption of air for moisture at various degrees of heat:

Weight of Water Absorbed by One Cubic Yard of Air.

At degrees F.	Grains of Vapor.	Increase of absorption. Grains.	At degrees F.	Grains of Vapor.	Increase of absorption. Grains.
32	60.50	18.31	131	1214.70	301.46
41	78.81	30.21	140	1516.16	361.10
50	109.02	40.09	149	1877.26	430.41
59	149.11	52.52	158	2307.67	506.42
68	201.63	65.78	167	2814.09	595.92
77	267.14	86.56	176	3410.01	690.43
86	353.97	106.79	185	4100.44	808.98
95	460.76	133.38	194	4909.42	929.66
104	594.14	166.85	203	5839.08	1070.73
113	760.99	222.49	212	6909.81	
122	983.48	231.22			

NOTE: One pound is equal to 7000 grains.

It will be seen by the table that as the temperature increases, the power of the air to absorb moisture increases, so that the

increased capacity from the last 9° of heat is about *fifty* times that of the first 9°. As there is always some moisture present in the air, the actual comparison is greater. When air is heated it becomes lighter and rises; therefore it is advisable to introduce the fresh or unheated air from below and pass it through the heating apparatus, enabling it to absorb its full amount of moisture in its upward course. If the air is left in the compartment until it has absorbed all the moisture possible at its temperature, and is given no chance to pass off, the drying process will cease; therefore it is necessary to furnish a supply of fresh air at the bottom and provide suitable means to conduct the moisture-laden air from the top. When these requirements are filled, the drying will be rapid and no trouble will be experienced.

Construction. Fig. 34 illustrates one of the modern drying and tentering machines now in extensive use. As will be seen it consists of a framework supporting numerous layers of steam pipes, between which passes a chain which carries the cloth. This chain is endless, and starting at the point where it begins its upward travel, it goes to the top of the machine where it passes around a roll and between the two top layers of pipes to the front end, here around another roll and between the second and third layers of pipes, and so on.

The piece, which is fed from a platform where the operator takes his place, is attached to pins fixed at the end of each link of the chain and carried along as the chain travels. Immediately above the point where the cloth comes in contact with the pins is a brush wheel which presses the cloth firmly on the pins. At the point where the cloth is fed in, the chain runs over sprocket wheels mounted movably on a shaft, so that the two chains may be brought nearer together at this point, making it easier to attach the cloth. As the chain travels upward the distance between the sprockets increases, until at the top of the frame it is full width. It will be seen that even should the cloth be narrow in places it is stretched to proper width by this means before the actual drying process begins.

The machine is enclosed, the partition usually being placed immediately back of the frame where the cloth enters, so that the operator is not exposed to the heat. The machine may be driven

either by a special engine or from the mill shaft, in which case cone pulleys are used to regulate the speed. The gears shown at the back end, of which there is another set on the other side at the front end, are driven through the shaft and gear placed at the

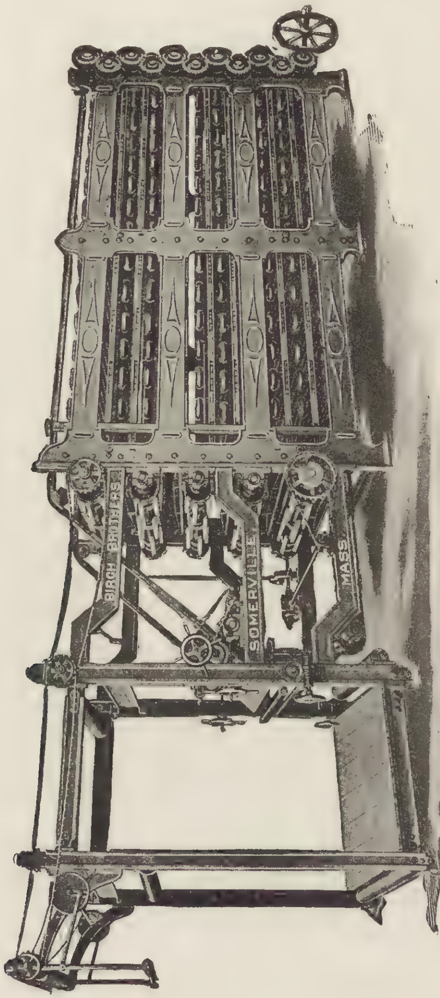


Fig. 34. Birch's Tentering and Drying Machine.

bottom at the right side. These gears in turn drive the shafts of the rolls and sprocket wheels to which they are attached, and with them the chain and cloth. A fan is generally fitted in the back partition to supply a sufficient amount of fresh air, as by so doing

the machine may be driven at a much higher speed than otherwise.

After the cloth has passed the entire length and come to the front for the last time, it is taken off the pins and passed under the platform to the top roll, from which it is folded.

Recently a new machine has been put on the market to extract moisture from goods, preparatory to the drying or other processes.

Pneumatic Cloth Extractor. This machine, illustrated in Fig. A, is entirely different from any previous type of machine

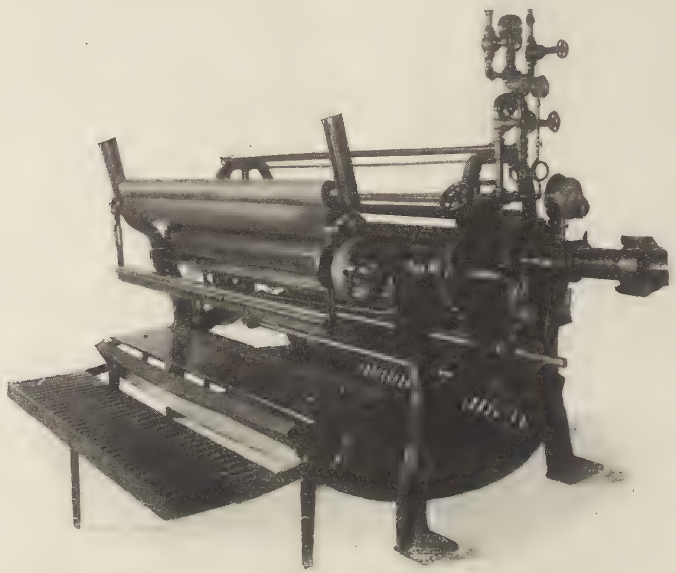


Fig. A. Stiner's Pneumatic Cloth Extractor.

and may be used for various purposes in the finishing room. The goods are taken roughly folded from the washers and run through this machine open-width, the water being extracted by means of a vacuum pump. A three-inch stationary brass cylinder having a slot cut lengthwise on top, extends across the machine and is connected to the pump. The cloth passes over this cylinder and by action of the vacuum pump much of the moisture is drawn from the cloth, passing through the cylinder into a discharge pipe. For ordinary work the vacuum is maintained at from 10 to 15 inches, but this may be varied by means of a regulator attached to the

end of the cylinder. Where the goods are to be gigged the vacuum is lessened so as to allow them to retain some of the moisture.

In the regular size machine the slot is 66 inches long, but it may be made any length required according to the width of the cloth. Two brushes are provided to lay the nap evenly before extracting, one to brush the face and the other to brush the back of the cloth. A sprinkler attachment is also provided on this machine, by the use of which the goods may be given a bath to remove all loose alkali or dye; the liquor being drawn from face to back. This will leave the goods in a brighter state, and as they are extracted open-width there are no cloudy effects.

The machine may be run at a speed of from twenty-five to thirty yards per minute, and leaves the goods in better condition than a centrifugal extractor. Any width or weight of goods may be extracted without any alterations of the machine being necessary. Such a machine may also be used to advantage in refinishing, as the goods are wet out open-width, thus removing the cause of creases which occur with goods run through the washers. A 6-inch single belt will run the countershaft from which the machine and pump are driven, the latter also using a 6-inch belt and the former a $2\frac{1}{2}$-inch belt. No special foundation is required for the machine to rest upon.

DRY-BEATING.

After the goods have been thoroughly dried, the next process should be a vigorous *dry beating*, and, though fair results may be obtained without such treatment, it is sure to give the goods a better feel and handle, besides making it much easier for the shear to do good work. The process consists simply in beating the cloth after it is dried, to loosen it up and counteract the stiffening effect of the water. The long exposure of the goods to moisture tends to make the fibres lay flat, and if, as on face goods, they have been subjected to a vigorous wet-gigging and steaming process, the fibres become pasted down to such an extent that unless properly loosened before going to the shear the raising brush will have to be put on very hard to raise them. Even then it often happens that some of them escaping treatment remain flat, thus giving the finished goods an uneven appearance. To prevent this, dry beat-

ing is advisable on face goods, though other classes of goods are improved to nearly as great an extent. The process of dry beating is often performed on an old up-and-down gig, but because of the extra handling entailed by its use it is preferable to construct a machine especially for the purpose. Such a machine has not as yet been put upon the market, probably because some finishers omit dry beating and others procure the same result, to a slight extent, on the brush.

BRUSHING.

After dry beating, the goods should be thoroughly back-burled, in order to remove from the back any knots or bunches which may have been overlooked in the first burling. They are then ready for the brush. Fig. 35 illustrates what is termed a *double-acting brushing machine*, which has also a steaming attachment, with the cloth all strung on ready for treatment. The view presented is a rear-end view showing the operation of the brushes, the left side simply having the driving pulley attached to the rear brush shaft. The cloth is put in the scray from the back with the number end first, thus turning the back of the goods out and the face towards the operating brush surface. The cloth is then drawn up in front, back of the small brush found there, and over the bar in front of the first cloth or delivery roll. The small brush in front acting only on the back of the cloth serves to remove flyings and such foreign material as may have gathered there. From the first bar it goes under and around the delivery roll, and over the three small rolls attached to the steamer; one of which is found below, the next a trifle above the steaming surface and the third on the same level back of the steamer. These rolls serve to keep the cloth from coming in contact, not only with the steam box, but also with the steaming surface which is covered with cloth, thus preventing the covering from being worn and the cloth from becoming streaked. The cloth then passes under the wooden roll set immediately back of the steaming attachment and up over the two application rolls, which are controlled by a worm and gear, and can be spread apart or narrowed by this means to increase or decrease the contact of the cloth with the brushes. Then the cloth goes down to and under a wooden roll set in the frame between

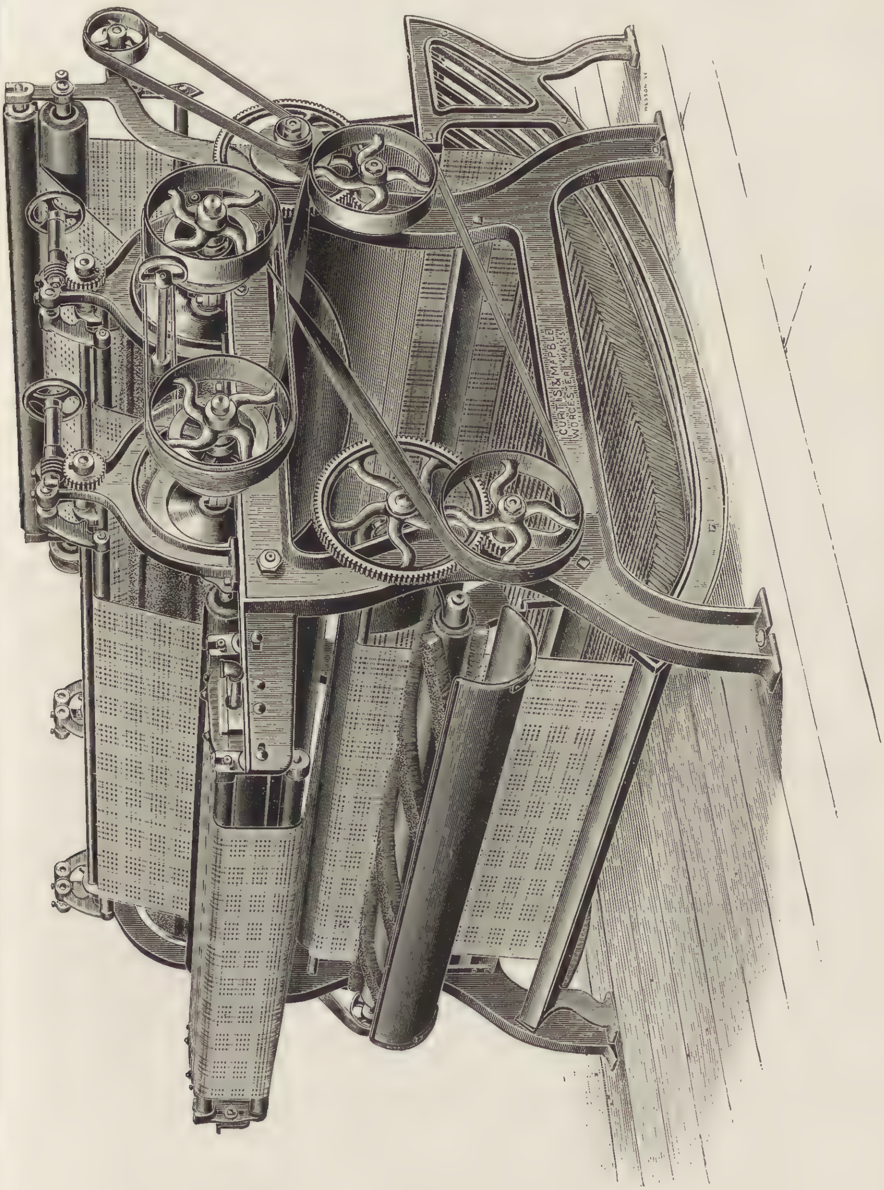
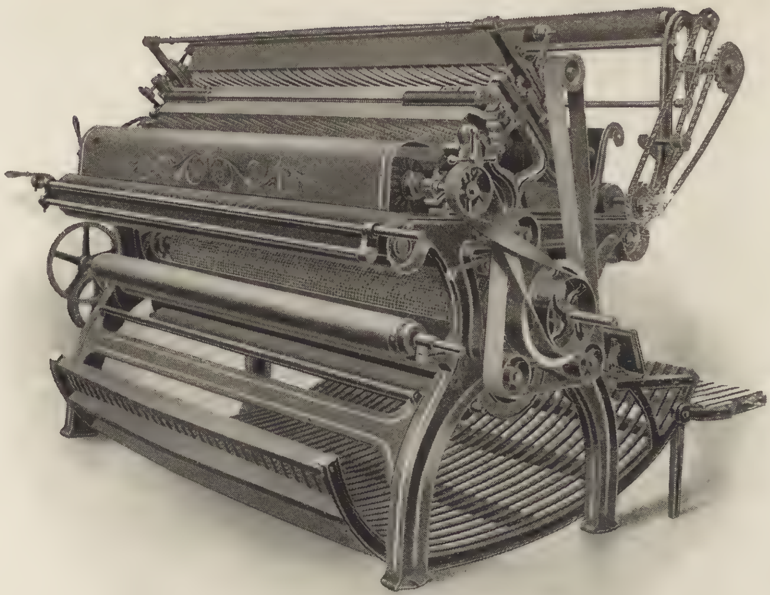
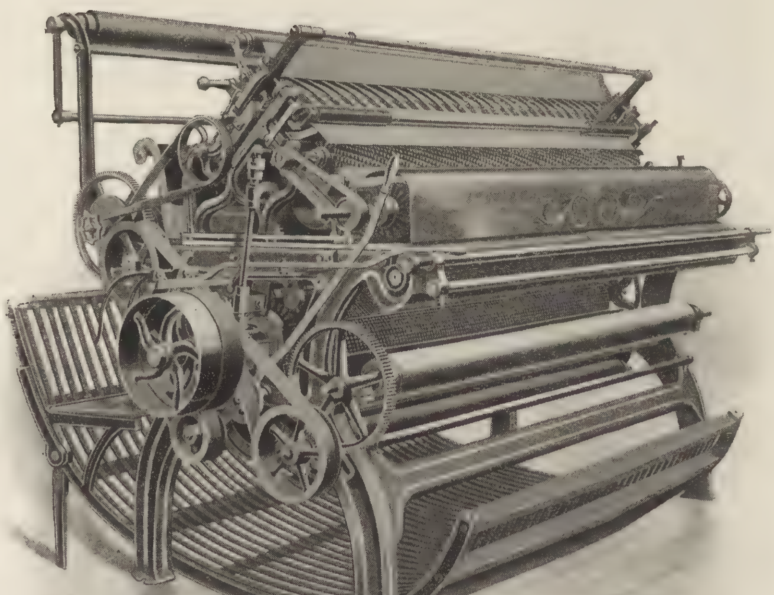


Fig. 35. Curtis and Marble's Two Cylinder Brushing Machine.





Figs. 36 and 37. Parks and Woolson's Single Shear.

the two brushes and up again, passing this time over the two application rolls of the rear brush. From there it goes to the take-up roll which actuates the cloth and to the top roll, from which it is delivered to the folder, either to be folded off or delivered into the scray for another run.

At the brush the goods are generally stitched together with one long, or two short wires, it being unnecessary to sew them at this point. The steam is turned on and the brush started up, the goods getting the beneficial action of both steam and brush. They are then ready for the shearing process, which is in many respects the most important operation in the whole process of dry finishing.

SHEARING.

Rotary Shears. Figs. 36 and 37 illustrate one of the latest improved *rotary shears* equipped with what is termed the list saving rest. The belting for these machines is shown in Figs. 38 and 39. Fig. 40 shows the rotary shear with the plain rest. Fig. 41 represents a double shear which is designed to afford means of doing double the amount of work with but one attendant.

Handling of Goods. The piece being nicely folded with the first end, or the end which usually carries the number, on top and the face from the operator in order to have the face out when running over the machine, it is then thrown into the scray at the back, and the first end drawn through as shown in Fig. 42. While it is customary to have the number placed at the front end during the first operation, that of burling, it is not arbitrary, depending as it does upon the whim of the superintendent. To one accustomed to it there is no difficulty in stringing on the piece correctly, but as it takes some time to become accustomed, it is always well to look the machine over to make sure that no mistake has been made. After the piece is strung on correctly, the ends are sewed together carefully, either by hand or machine. If by hand care must be taken to make small even stitches in order that a smooth seam may result, as it is possible to run the seam closer to the blades and thus save a little from the head ends which must afterwards be cut off. A few inches saved on each piece will make a yearly total well worth considering.

Description. The dotted line shows the path of the cloth through the shear. It first passes over the front rod A. This is convenient to the hand of the operator, where he can see that the cloth goes into the machine straight and free from wrinkles.

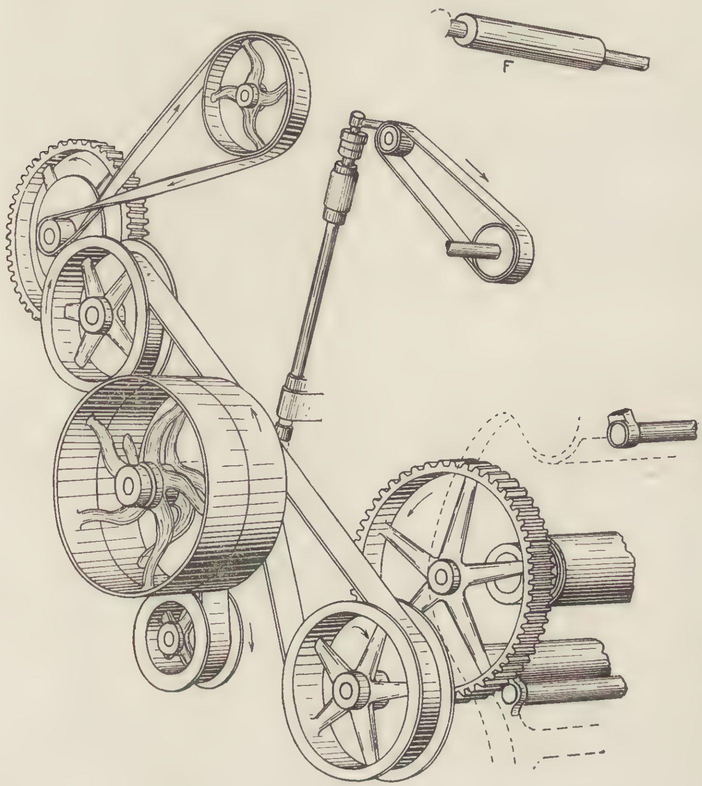


Fig. 38. Left Side Belting.

From there it passes under the idle rolls B and C and over the draft roll D. The draft roll D draws the cloth from the scray U beneath the machine, pulling on the back of the goods so that the nap on the face is not displaced: from there it passes over the brush rest F, where the raising brush E raises the nap so that it stands perpendicular to the face of the goods, in a fit condition for shearing. The nap of the cloth always points toward the front of the shear away from the blades, and the raising brush, revolving in the direction shown by the arrow, will therefore cause the nap

SECTION OF SHEARING AND SINGEING ROOM
Firth & Foster Co.

to stand up straight. The brush G is a flock brush which cleans the back of the cloth from threads and flocks before it goes over the rest H, where the fly blade I revolving against the stationary knife Y cuts off the nap from the face of the goods. The screw

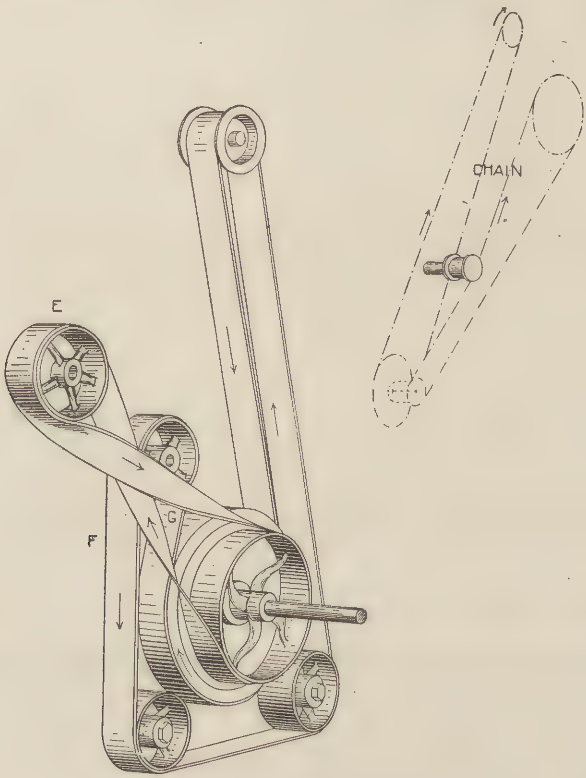


Fig. 39. Right Side Belting.

X adjusts the cutting edge of the blades to or from the rest so that the nap may be clipped to the proper depth. The blades may be swung back from the rest around the pivot W by lifting on the handle V, this being necessary when a sewing, uniting two cuts of cloth, passes over the rest. The swab Z is a strip of leather saturated with oil, resting against the blades to lubricate them. From the rest the cloth passes over the adjustable guide rolls J and K and the stationary idle rolls M and N, which apply the face of the goods to the laying brush L. This brush lays the nap again and

frees the face of the goods from flocks. From there the goods pass over the draft roll Q and idle rolls O and P, to the small draft roll on the folder R. The swinging folder S lays the goods in folds, as it descends from the rolls R into the scray U, where it passes under the machine for another cut, or to the folding table T, when it is not to be sheared again.

All the brushes have suitable *flock pans* beneath them to catch the flocks, and the blades also have a large flock pan beneath

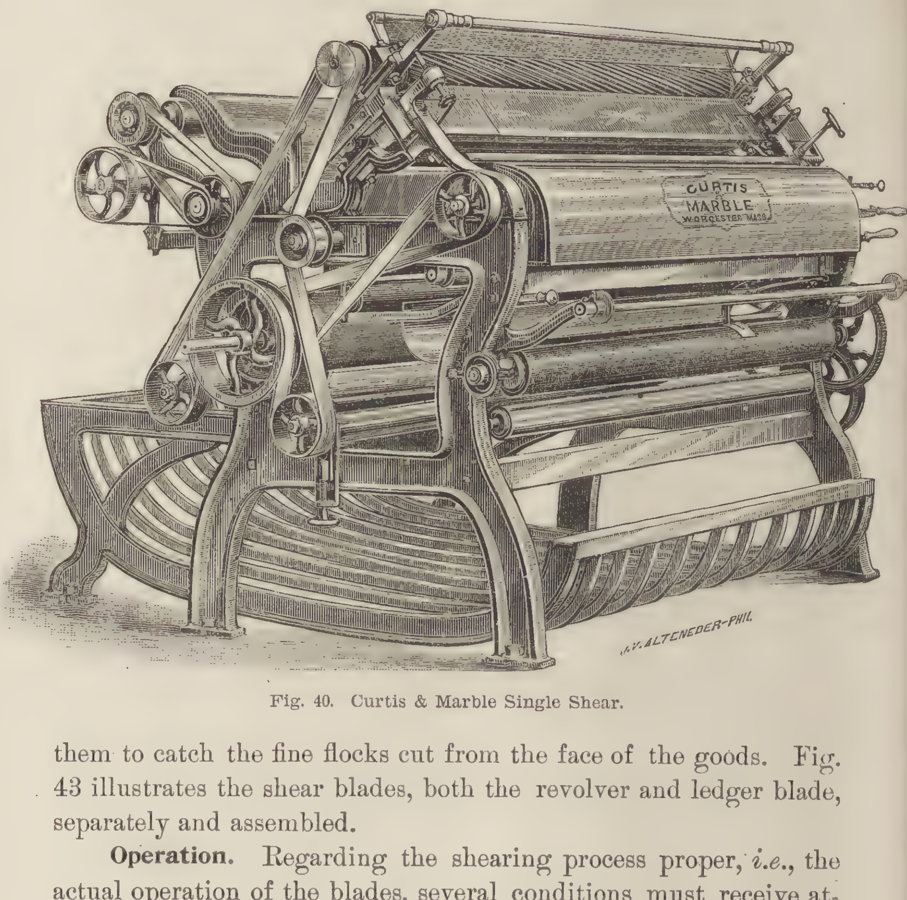


Fig. 40. Curtis & Marble Single Shear.

them to catch the fine flocks cut from the face of the goods. Fig. 43 illustrates the shear blades, both the revolver and ledger blade, separately and assembled.

Operation. Regarding the shearing process proper, *i.e.*, the actual operation of the blades, several conditions must receive attention. On the first run the nap should be only slightly trimmed: to what extent can only be decided by the careful judgment of the shearer himself, as different fabrics require different treatment.

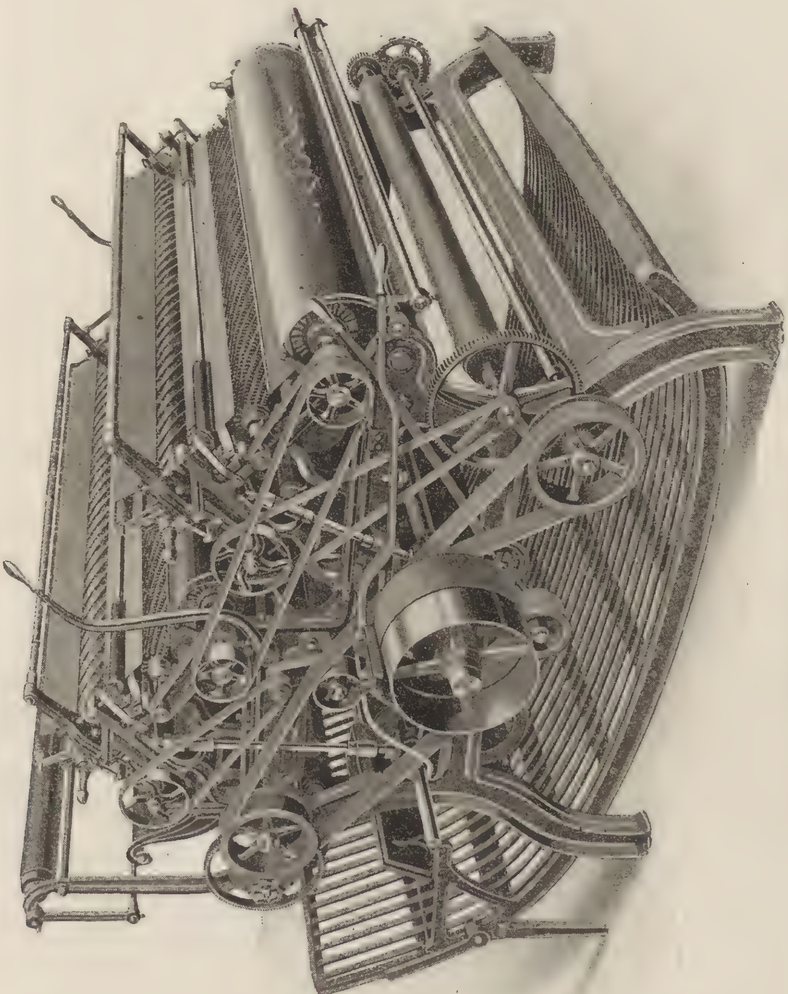


Fig. 41. Parks & Woolson Double Shear with List Saving Rest.

When all the nap is on the goods it is of uneven length, and the greatest amount of work is required from the shear, therefore it must not be overloaded at this time.

Blades. When in good condition the shear runs lightly and noiselessly, showing that the blades do not press against each other

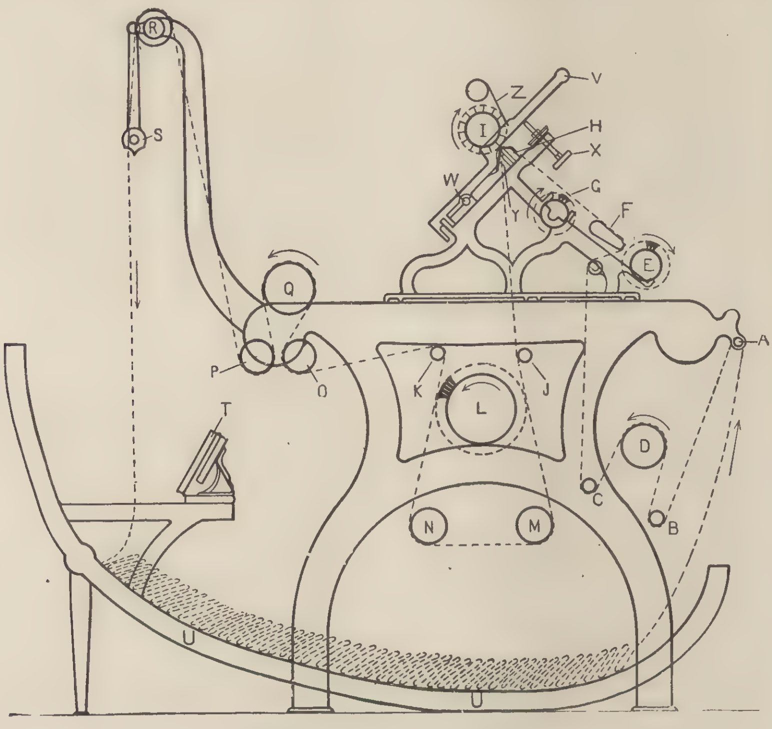


Fig. 42. End View of Shear.

any harder than is actually necessary for cutting purposes. It is clear that under these conditions it will not take much to spread the blades apart so that they will not cut at all, and this is often caused by crowding more nap into the blades than they can properly handle. Sometimes it is assumed that the blades are dull because they do not perform all the work expected from them, when the trouble is caused entirely by overcrowding. Another indication that more is being expected from the blades than can be properly done, is the carrying along of flocks by the revolver, which throws them over in front onto the cloth, to be again taken

up by the blades. Nothing will spoil the cutting qualities of a shear faster than this, and it should be stopped at once by setting off the blades. As the accumulation of flocks back of the cylinder must also be avoided, their frequent removal is necessary.

After the blades are set as the shearer's judgment determines, the shear may be started up and sufficient cloth run so as to see just how much is being taken off. During the first run the nap

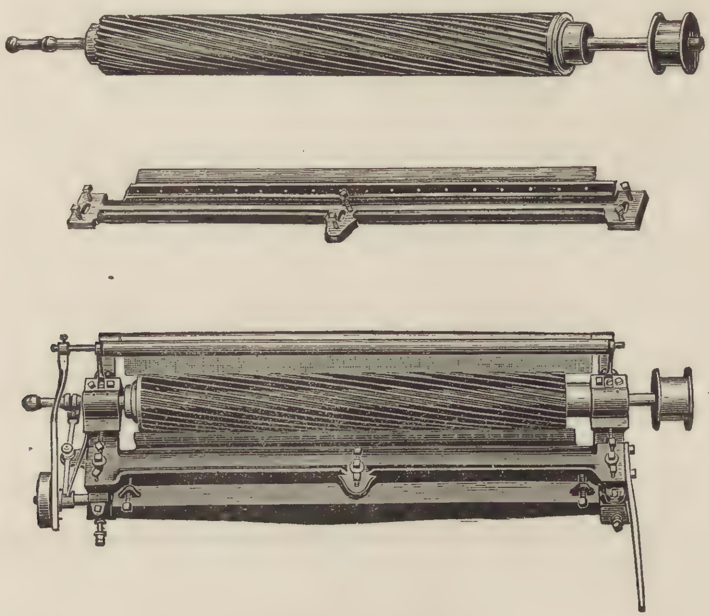


Fig. 43. Shear Blades.

is cut to a comparatively even length, and for the second run the blades may be let down two or three notches, according to the thickness of the nap. Of course the nap is thicker close to the cloth and the blades should be regulated accordingly. If the nap is at all thick it is not advisable to turn down more than two notches, and as the shearing progresses it is better to go even more slowly, giving an occasional run without letting down any. The goods should be *watched closely* as they are being sheared to see that they are running smoothly and without wrinkles. The blades are lifted when the seam comes up so as to allow the seam and that part upon which the number is placed to pass without shear-

ing; if the blades were not lifted the seam would be cut. The seam is run as closely as possible to the blades so as not to waste cloth. The raising and lowering of the blades must be done quickly, but without jarring, otherwise the parts would be likely to get out of true and damage would result.

There are many persons who hold that shearing is an exceedingly simple operation, but a man to be a good shear tender, must like and study his work in order that he may know how to remedy any difficulties which arise. A boy may be able to start and stop the machine, lift up and let down the blades, turn the notches up or down, etc., but that will not make a good shearer of him unless he is a close student of his work. The best position for a shearer to stand is at the side of the shear next to the shipper handle, because he should be close to shipper handle, and any irregularities in shearing may be noticed more readily from the side than in front. If for any reason the shear refuses to cut properly it should be stopped immediately and the fault remedied, or permanent damage may result, for when the blades refuse to cut the nap there is great danger of its being pulled out.

Tension. The tension on the goods must also be carefully attended to, for the tighter they run over the rest, the harder it is to clear them out properly, if they are to be close-finished. On the other hand, it will not do to have them run too loosely, especially on such threadbare goods as worsteds, etc., because there is then danger of cutting at the edges, even if the shear is provided with list saving motion. A good test for tension is to place the hand on the goods at about the middle of the blade rest, and if on bearing down slightly a slight wrinkle is caused, the tension is right for average work. If a wrinkle appears only under heavy pressure the tension should be lessened, and if the wrinkle appears too easily the tension should be increased. There are times when the goods must be drawn as tightly as possible in order to shear them at all, but such cases should not occur often, and are a sure indication that something is radically wrong at some other place. These directions apply only to the solid rest shears, it being necessary to meet different conditions for the rubber rest shears, as will be explained later.

Tension Device. The tension is governed by a device attached to the shaft of the take-up roll as illustrated in Fig. 44. A is a gear having a plate in its center about 9 inches in diameter, and is mounted loosely on the shaft against a collar D, which is rigid on the shaft. Immediately in front of the plate a slot is cut

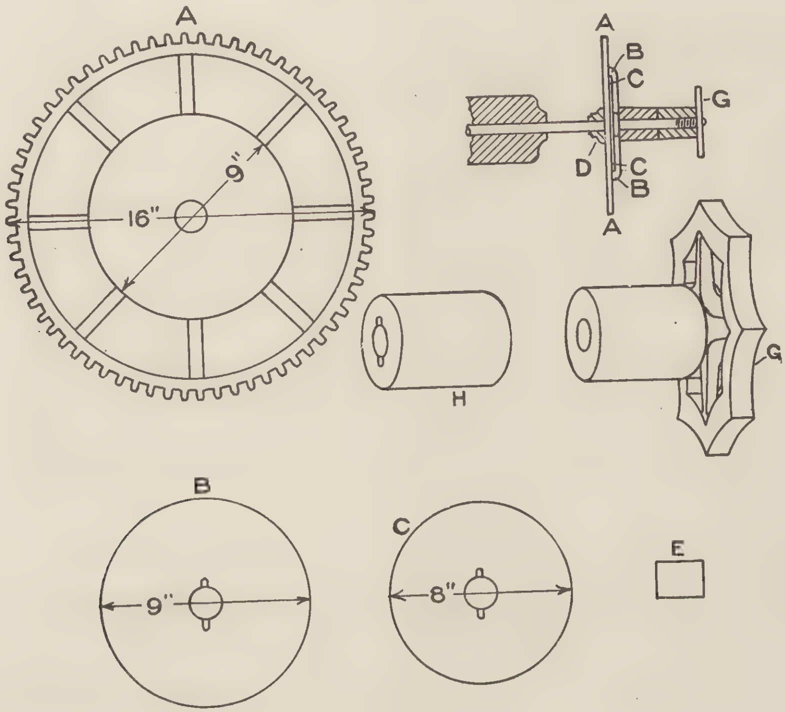


Fig. 44. Tension Device.

through the shaft, into which the key E fits, projecting on both sides. A leather plate C, 8 inches in diameter, is then placed over the shaft against the plate of gear A, and after adjusting, the key plate B is also put on the shaft, and pressed against C in such a way that the key slips into the slots cut for this purpose. The collar H which also has slots for the key is next put on, and finally the hand wheel G which serves as the locking device, being threaded to fit thread on end of shaft, is screwed on the end of the shaft pressing the several pieces together. By this it will be seen that if G is screwed on hard the whole becomes almost as one piece,

while if G is loosened the pressure against the plate is lessened and the roll will not turn quite as fast as the gear A.

The List-Saving Rest, or, as more commonly known, the "list motion", is a rather intricate mechanism, requiring careful attention to get good results. It consists of a great many pieces forming, when assembled, a mechanism which will follow the edge of the cloth automatically in whatever position it may run. As the name implies, it serves the purpose of saving the list not only from being cut, but also from being sheared, this being considered undesirable on most goods.

Construction. The motion, as illustrated in Fig. 45, is composed as follows: A is the frame stand; B, the main shaft of shear; C, the bevel gear shaft; D, the eccentric; E, the eccentric connections; F, the connecting links; G, the ratchet; H, the ratchet catch; H^1, the inner serrated plate attached to H; H^2, the loose outer serrated plate; I, rest proper; J, sections of list protecting surface of rest; K, sliding bar with cam-shaped spline, L; M, finger attached to sliding bar to hold feeler catches; and N, the guard plate.

Operation. The bevel gear shaft C, which derives its power from the main shaft B, is attached at its upper end to the eccentric D, which in turn is attached to the connecting rod E. The short connecting rod F is pivoted to the point indicated near its center, and being connected with E at its lower end and with the long connecting rod at its upper end, when the machine is started up these links will have a reciprocating motion imparted to them. As the eccentric point D is movable, this reciprocating motion may be varied according to the position of D. The nearer this is set to the center the shorter the stroke, and *vice versa*. The long connecting link F extends from the short link on both sides to the ratchet G, which is fastened to the link F, in this way imparting motion to the ratchet. This is the foundation of the list motion as it operates on both sides of the machine. The remainder of the machine may be in action, but the "rest" may as well be of one solid piece if the ratchet fails to work.

The list-protecting surface of the rest is composed of from thirty to fifty separate sections of steel which are finished so uniformly that when properly set together, they form an unbroken

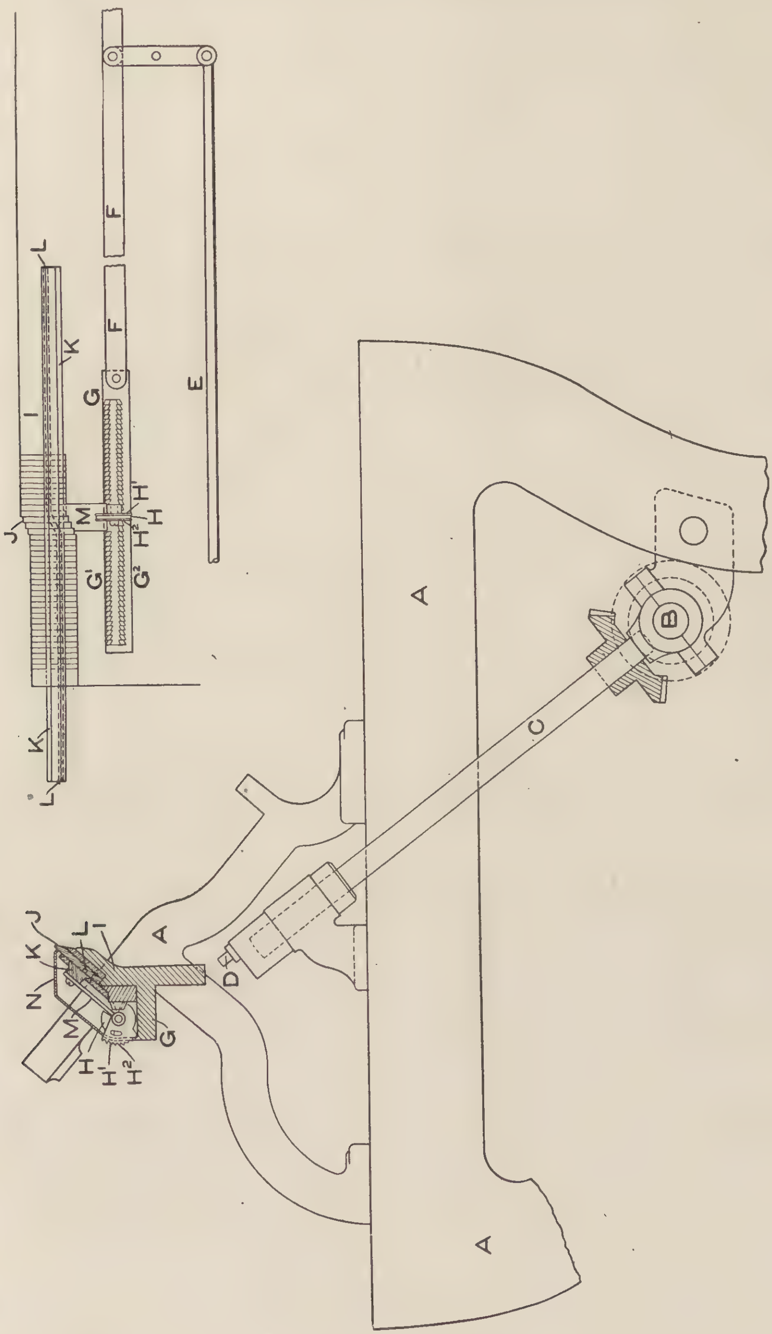


Fig. 45. List Saving Motion.

surface like one piece. These sections are grooved on the front side to receive the cam-shaped spline L, attached to the sliding bar K, the position of which may be traced by the dotted lines. This spline, as shown, extends diagonally from the lower end of the sliding bar to the upper at about its center, and consequently the several sections of the rest on the inside are higher than those on the outside, the inner sections being on the same level as the solid part of the rest.

As the cloth passes over the rest under moderate tension, any part of it passing over the lower part of the rest will be so far away from the cutting point as to pass without being touched. In order that only the list shall pass over the depressed part, the finger M, which is attached to the center of the sliding bar, comes down over the ratchet and carries at its end the feeler catches attached at such points as H, H^1, and H^2. The part H, to which the serrated part H^2 is attached, has on the end next to ratchet G an upper and lower jaw which may engage with either set of teeth in ratchet G, as indicated at G^1 and G^2. The upper set of teeth G^1 will take the feeler catch outward and with it the finger M and the sliding bar. The spline L, on the sliding bar, will then raise the several pieces through which it passes to their proper places. The feeler catch H and its serrated plates will, by their own weight, drop into the lower teeth of ratchet G^2, and be moved inward. The movement of the cloth will lift the serrated plates, and as long as only the edge of the cloth is in contact will hold them sufficiently in suspension to keep them from coming in contact with either set of teeth in ratchet G, and thus they will remain stationary. If the edge of the cloth moves outward over the feeler catches, the contact becomes sufficient to raise the feeler catches and engaging them in G^1 move outward to the edge of the cloth. When the strain on the feeler catches is released, either by reason of the edge of the cloth moving inward or the feeler catches coming to the edge of the cloth, they drop at once and engage with G^2.

Adjustment. Each side of the shear has a separate *list-saving device* independent of the other, except that both are driven by the rod F. The guard plate N is put on simply to protect the working parts from flocks, and from coming in contact with the cloth. The many sections composing the rest must be kept clean,

and should be so adjusted as to work easily without being loose. If they are loose the chances are that the goods will not shear as closely as on the other parts of the rest, and if too tight the cloth will pass over the feeler catches without being able to operate them, or if going the other way they will not follow the cloth fast enough to prevent it from being sheared.

It was formerly the opinion, and is now to some extent, that the list motion should be kept thoroughly oiled, but it has been proven by experience that flake graphite is a superior lubricant for the purpose because it does not collect dust. The best way to use graphite for this purpose is to shake the pieces with graphite and then replace them, not wiping off the superfluous graphite. As the sections are all numbered, there is no chance of replacing them incorrectly. The spline should also be well dusted before being placed in position. The bar which is placed on top of the cloth to keep it in contact with the feeler catches requires careful adjustment to obtain good results. If it bears on too heavily, the feeler catches are engaged too much and keep working outward, thus allowing the list to be sheared or even cut; and if it does not bear on enough the feeler catches will fall, and the bar travel inward, leaving a strip of cloth inside the list unsheared. If the above precautions are taken there should be no trouble experienced in obtaining good results from the list motion.

Grinding and Fixing. To gain a thorough idea of the fixing necessary to be done on a shear, it is best to begin with the *grinding* and follow through all the operations until the shear should be ground again. Nearly every finisher has a system of his own when grinding, but however much the systems differ the principles and results desired remain the same.

Operation. First run out all the cloth, then remove and clean the swab, and after thoroughly cleaning the flocks, etc., from the revolver, remove that also. Next carefully clean the ledger blade and apply the straight edge to test it for evenness. It rarely occurs that the blade is uneven if the shear has been properly handled, unless the blade has soft places or imperfections which cause it to wear unevenly. Assuming that it was found to be even, test it to see if it is adjusted to the rest so as to bear evenly all across. If at any point it does not bear as heavily as it should,

turn in the lower screw in the bed-plate until the blade binds evenly everywhere. When this adjustment is as it should be, cover the rest and list motion carefully to protect them from the emery, and replace the revolver. Then loosen a trifle the upper row of screws, which adjust the ledger to the revolver, evenly all the way across and drop the revolver one-half a turn. Cross the revolver belt, remove the other belts and disconnect the list motion, as there is no necessity of running any other part of the machine than the revolver, which is run in the reverse direction. Next start the machine and apply to the revolver a mixture made up of oil and emery, on a strap about 12 inches long by 4 inches wide, moving this briskly from side to side in order to distribute the mixture evenly. This mixture is made up of good lard, or neatsfoot oil, with equal proportions of flour of emery, and No. 120. It should not be too thick nor applied in too great quantities.

In order to distribute the mixture most evenly on the revolver apply the strap at a different place each time, *i.e.*, first at one end, then at the other, and next the middle, etc. After a thorough application draw the blades together by means of the top row of screws at the back; this must be done evenly, or uneven grinding will result. The best way is to draw up one side screw first, then the other side screw, next the middle, and finally the quarter screws. This process of applying emery and drawing the blades together is repeated until the grinding reaches the edge of the ledger blade, giving each application plenty of time to work in order to insure good results. When the edge is turned forward all across the ledger blade, a mixture of oil and flour of emery is used, without the No. 120, running this for about ten minutes. If by testing with dry tissue paper the latter is cut clean at every point across the blades, the use of emery may be discontinued, otherwise continue grinding until such is the case. Now clean the strap and apply oil for about ten minutes, and then draw up the revolver about a quarter turn and run for about five minutes with a further application of oil alone, this finishing the grinding process.

After grinding, clean the whole machine thoroughly, the revolver being removed for the purpose, so as to make sure of the complete removal of the emery, which is thrown about a good deal during the grinding process. Then hone the ledger blade by ap-

plying the well oiled hone to the blade, with the lower end from two to two and one-half inches away from the blade so as to make an angle of about 70 degrees. This will turn back the feather edge, which has been turned to the front during the grinding. Replace the revolver and turn one or two revolutions in the cutting direction to cut off the feather edge, and the shear is ready for operation. It will now be found by trial that the blades will cut fine wet tissue paper. The practice of grinding until the blades will cut fine wet tissue paper before honing the ledger blade is not to be encouraged, as it is necessary to grind off the feather edge before the paper may be cut, and after the blade is honed another edge will be turned which also must be cut off. By doing this the blade is worn out faster than is necessary. While any unevenness in the revolver is seldom found, it should be tested occasionally with the straight edge, and also at either end with calipers to see that both ends wear alike. Apply the straight edge to the ledger blade both before and after grinding.

When the shear is properly operated, the ledger blade is not often found to be uneven, unless it contains imperfections which allow it to wear faster at some points than others, but if it is found to be uneven before grinding it must be evened first. If the ends are higher than the middle they will bear more heavily against the rest, and adjustment in that position will eventually destroy the alignment of all the parts. When for this reason it is necessary to grind down the blade the end screws only are used to bring the blade in contact with the revolver; while if on the other hand it is high in the middle, only the middle screw is drawn down. The harder the two blades are drawn together the more will be ground off, but the work must be done slowly to prevent unduly heating the blades.

When grinding, the revolver, ledger blade, and rest must always be kept *parallel*, with the rest centered as nearly as possible under the revolver. This may be tested by placing a try-square against the mark found at the inner end of the empty revolver-box, and bringing against it the end of the straight edge placed on the ledger blade. If they meet squarely, the adjustment is correct.

When *setting up a new shear or replacing refitted blades*, first put on the shear the blade frame which carries the blade, and

insert the center stay bolt, but turn this in only part way. Then adjust the cutting edge of the blade parallel to the rest, with both ends equally high, and screw down the stay-bolts moderately tight. Now replace the revolver and adjust the blades to it equally by means of the top row of screws, at the same time tightening the lower row of screws until they touch the bed. This done, carry out the grinding process as previously explained.

A simple way of testing the adjustment of the ledger blade to the rest, is by setting the ledger about $\frac{1}{16}$-inch from the rest and balancing a penny on each end, when by sighting across, the pitch of the pennies will indicate what change if any is needed. After adjusting for height, test for distance by using as a gauge the blade of a pocket knife, or some similarly tapering instrument, to insert and slide across between the rest and the ledger blade. Any variation will be shown by the varying amount of binding. Sometimes a smooth wooden wedge is used for the same purpose when, by marking it at the first point, any variation is indicated by the different depths to which it may be inserted. Adjust the blade to the rest by moving the carriage in whatever direction required.

Another successful method of grinding is as follows: After proper preparation as previously described, draw up the revolver one-quarter turn, instead of setting the ledger blade to the revolver as in the former method. Apply the emery in the same manner as before and run a few minutes, then let the revolver down one-quarter turn, applying more emery as required, and run in this position for about half an hour. Then lower the revolver another quarter turn and, after running in this position for about fifteen minutes, test the blades with a strip of newspaper. If the newspaper is cut clean all across, continue grinding, using flour of emery and oil for fifteen minutes and then finish by running with oil alone for half an hour. Now hone the ledger blade, clean the machine, and otherwise make it ready for operation in the usual manner.

As the *ledger blade wears down* to the thicker portion, the bevel at the grinding point becomes larger, bringing too much surface of the blades in contact, and consequently the blades run harder and tend to make more noise. This may be remedied as follows: When getting ready to grind, after observing the usual

precautions as to adjustment, replace the revolver in the boxes and fasten down the caps. Then loosen the top row of screws about half a turn and let the revolver down one full turn on the top screw, or if the bevel is excessively large a turn and a half is not too much. This being done test the blades with a piece of tissue paper to find how hard they bear against each other. As the paper should pass between them easily, by holding it in one hand and turning the revolver with the other, the evenness of adjustment at all points may be determined and regulated accordingly. When adjusted correctly, grind as before, using No. 120 emery, or coarser if the amount of bevel requires it; drawing the blades together gradually in order to avoid the heating caused by overcrowding. By careful observation it will be noticed that the cutting edge of the ledger, which at first is some distance from the revolver, comes closer at each drawing of the blades, until when the heel is sufficiently ground off, the two blades come almost in contact. At this point, on removing the revolver, the back of the ledger blade will appear as at Fig. 46. Reducing the amount of bevel relieves the blades from excessive contact, allowing them to run more easily and with less noise.

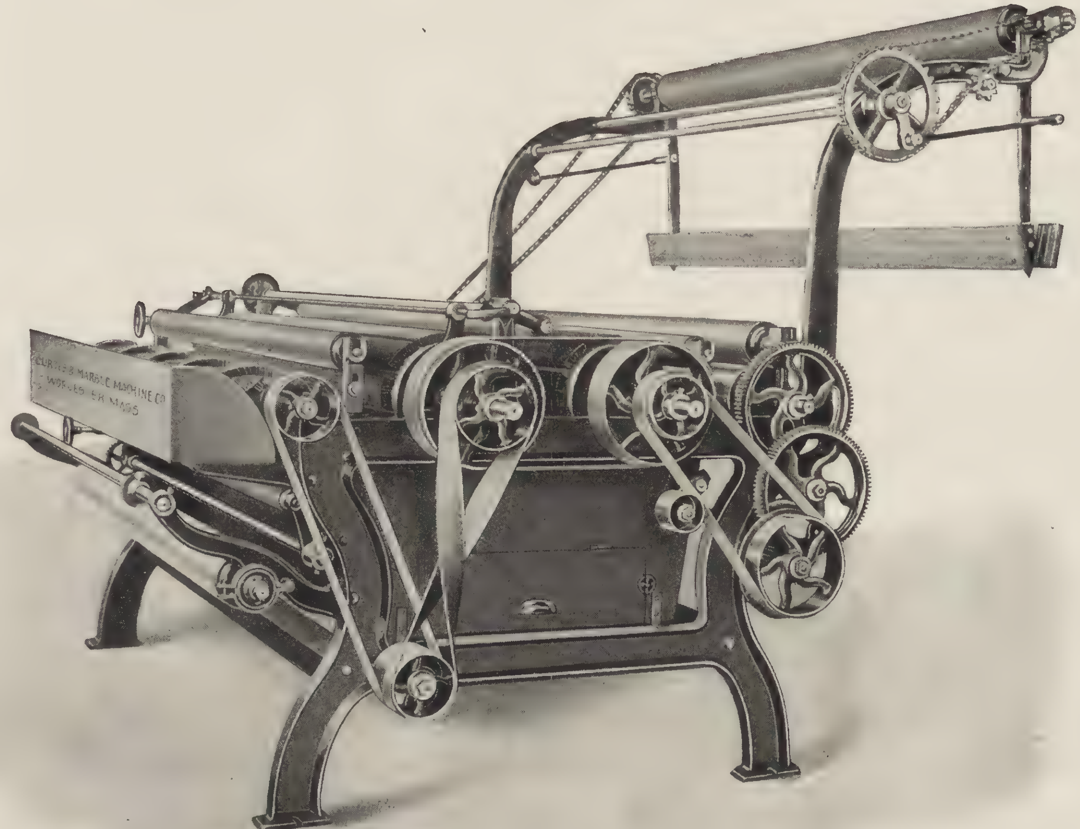
Fig. 46. Ledger Blade.

The revolver, when replaced is drawn to within one-quarter turn of its former position and the blades are sharpened in the usual manner. After repeated grinding, however, the ledger blade wears down to such an extent that it becomes necessary to grind it down on the front. The reason for this is that all the blades of the shear, the ledger blade as well as the knives of the revolver, are only partially steel, the remainder being a reinforcement of iron. On the ledger blade this iron, which is in front, is easily distinguished by the different appearance, as the steel, which extends about one-half inch from the edge, shows brighter than the remainder, which is iron. It will also be noticed that the front of the ledger has a very long bevel. This serves two purposes, one of which is to expose the steel so that the iron will not come in contact with the knives of the revolver, and the other is to allow a free passage of the cloth between the blade and the rest.

Shear Grinder. When the steel face becomes so worn down as to expose the iron, the shear will not cut and it becomes necessary to "face" the blade. The machine illustrated at Fig. 47 is used for this purpose. This machine is provided with a cast-iron cylinder which is ground to a uniform diameter, and is fitted with rests to hold the ledger with its frame, and the revolver. The ledger frame is placed in the top rests which are shown in the illustration as having hand-wheels attached, and the revolver is placed in the front rests which are similarly shown. The blade is so adjusted on the machine as to have the cylinder strike it far enough back of the old bevel to expose sufficient steel on completion of the grinding. The blade must be brought in contact with the cylinder evenly, and the grinding continued gradually until the edge is reached, using No. 120 emery mixed with good oil. If the bevel at the cutting part is too large it may be reduced in this operation by striking in a little deeper at the beginning and continuing the grinding a little longer. In this way the bevel in front is retained sufficiently large to allow the free passage of the cloth. A material saving may be effected in large establishments with one of these machines, by having on hand an extra set of blades with which to replace any needing attention, thus keeping the machines in constant operation.

The *revolver knives* being reinforced with iron similarly to the ledger blades, will also wear down so as to require attention. This occurs at the short bevel on the back of the knife, and is remedied by the operation of "backing off", when the revolver is placed in a lathe and sufficient iron removed to insure good cutting qualities. As this process is a slow and tedious one, it is usually done more cheaply as well as better by the machine builders. When the desired amount of iron is removed the revolver is ground evenly on the grinder; and then both revolver and ledger blade, after being properly adjusted on the shear, are ground in the regular manner.

The ledger blade must be set carefully in combination with the rest or bad shearing is sure to result. The cutting edge of the blade should be just barely visible when the machine is in operation, therefore the thickness of the goods governs the height to



TWO-CYLINDER SINGLE-ACTING BRUSHING MACHINE WITH HIGH FOLDING ATTACHMENT

Curtis & Marble Machine Co.

which the blade must be set. If the blade is set too high, it is liable to nip the cloth; and if too low, to scrape it.

Sometimes after grinding the blades will rattle, and in such case either the ledger may be slackened a trifle at the ends, or the bevel may be honed a little at the ends, as a preventive. If the blades fail to cut at the ends, the remedy is to draw up on the conical screw found at the end just underneath the revolver journal boxes.

Adjusting. After a shear is ground properly it should run easily, and almost noiselessly, because, as the blades are sharp, it is

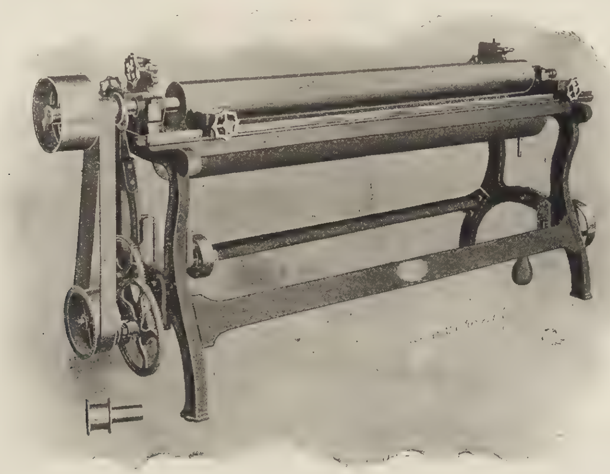


Fig. 47. Parks & Woolson Shear Grinder.

not necessary to draw them together tightly, and thus create friction. Some shears, however, will always make a certain amount of noise even through the friction between the blades is reduced to a minimum. This is due to the knives of the revolver increasing the volume of noise by exerting a fan-like action on the air, and is always more noticeable in connection with revolvers fitted with a small number of knives. As the different makes of revolvers vary little in diameter, it is apparent that when the knives are few in number they will be farther apart and a greater fan-like action will result.

Skipping, *i.e.*, leaving the nap uncut in spots, is a fault occasionally met with in the operation of the shear immediately after

grinding. The usual cause is that the blades have not settled into their proper place after honing and cleaning, and the fault would soon remedy itself if it were not for the nap getting between the blades and spreading them. Sometimes it is caused by overcrowding the blades in starting up, thus spreading them too far apart. The best remedy is to ease up a little on the "heel" of the ledger blade; the heel being the back edge of the bevel caused by grinding. By moving the revolver forward and upward it is taken out of contact with the blade at the heel, and caused to bind a little more at the cutting edge. This improves the cutting qualities without causing the revolver to run any harder. Adjust the revolver in the required position by drawing up one-quarter turn on the adjusting screws, which pass through lugs in the frame into the revolver journal boxes, after first loosening the journal binding screws. After adjustment, reset these screws, and on starting up the shear the skipping will be found to have been corrected. Sometimes skipping is corrected by drawing the blades together, but it is not advisable to do this before it is made necessary by the wearing of the blades. Some shearers contend that the blades will not cut clear unless closely drawn together, but with the one exception of shearing mixed goods it is not so. It is, on the contrary, a disadvantage, because the revolver runs much harder, and grinding is required more frequently. If drawing together is deemed advisable it should be done evenly all the way across, not only at the point where the skipping occurs, as is done in some mills. Blades so treated soon become unevenly worn, because of the uneven setting, and require the expenditure of much time and labor, as well as much "blade" to rectify the trouble.

Care of Shear. To obtain the best results from the shear, some system of attention must be followed out, and the system here presented has been proven a good one. The first time the blades require attention remove the revolver and hone the ledger blade. The next time, strop the revolver with oil for about ten minutes. The revolver is of course run in the opposite direction during this operation and is kept from contact with the ledger by inserting a piece of thick strawboard under each journal box. By alternating in this manner and drawing the blades together only slightly as required, the shear may be kept running continu-

ously for eighteen months in the best condition. Another good system to follow is to hone the ledger blade once in two weeks, and strop the revolver once a month. This treatment also should keep the shear in good running order for from twelve to eighteen months.

Spreading of the blades is often caused by overcrowding, *i.e.*, by trying to shear off too much nap on the first run. When this happens all that can be done is to draw the blades together again, but the trouble is that much more drawing together is required than would otherwise be necessary. A seam coming up unnoticed will, beside becoming cut itself, spread the blades. They are sometimes injured by this cause to such extent as to require grinding. This never happens when the shear tender is wide awake, and giving the necessary amount of attention to his work.

Defective Work. When, during the shearing process, it is found that the edges of the cloth are not being sheared as closely as the middle, the condition of the blades should first be ascertained. If the blades are found to be in good condition, the trouble is probably caused by flocks gathering in back of the sections of the list motion. The remedy is to clean and lubricate the latter as described previously. With solid or plain rest shears, the only place to look for fault is in the blades. Poor shearing in the middle with good work at the ends is usually caused by the take-up friction being set too tightly. This being the case, the take-up roll tends to draw or take up more cloth than is fed in by the delivery roll, because with a tight friction the surface speed of the take-up roll exceeds that of the delivery roll. Should it not be possible to adjust the friction correctly, it should be taken apart and cleaned thoroughly, especially the leather disk which fits between the two plates. This should be rubbed well with gasoline, which will clean off the dirt and grease. On reassembling the device the trouble will be found to have ceased.

Oiling. With reference to oiling there is a great variety of opinions, as to the kind of oil to be used, quantity, and method of application. The blades are oiled by means of a swab of felt or leather, which is saturated with oil to the desired extent. This swab, which is four or five inches wide, is attached to a wooden roll resting in lugs attached at the side of the revolver boxes, and covers the top of the revolver. The oil passes from the swab to

the revolver, which in turn conveys it to the ledger blade. If too much oil is applied to the swab it is carried along and runs to waste down the front of the ledger blade. The spaces between the knives of the revolver gradually become filled with flocks, which are first collected by the surplus of oil, but as they increase in quantity they absorb the oil and *serve as a reservoir.* For this reason it is well to allow the flocks to remain as they collect. Another reason is that in the event of any part of the blade becoming heated because of excessive friction, the oil will immediately run to such part, thus lessening the friction.

It should not be necessary to apply oil to the swab more than twice a day, because the fact of the blades running so hard as to require more oil is sufficient evidence that they are dull, and require grinding. One exception to the foregoing statement is in the case of shearing cloth composed of mixed cotton and wool yarn. The more cotton the cloth contains the harder it is to shear, because cotton fibre is not cut as easily as wool. This does not apply to goods which contain all cotton yarn, as no difficulty will be experienced with these; but with mixed goods it is sometimes necessary to oil for every piece. The oil should never be applied in sufficient quantities as to run down the front of the ledger blade.

The *quality of the oil* must also be considered. It should have good body, and be free from the tendency to gum. Some of the different oils used are castor oil, double refined lard oil, sperm oil and neatsfoot oil. The chief advantage of castor oil is the body, and in the winter this becomes a disadvantage. In winter white sperm oil is the best if pure, but unfortunately it may seldom be obtained, and then is usually too expensive. Pure lard oil may be easily obtained, but it has not sufficient body to recommend its use, especially on fine goods. Neatsfoot oil, even if not double refined, has all the essential qualities for a good shear oil, being of good body and having been proved by experience to be free from tendency to gum. Five gallons of this oil should be sufficient to supply one shear for a year. If more is used it is wasted or the shear is not kept in good condition.

Oil streaks in the cloth result from various causes, but one of the most prolific is the gathering upon the ledger blade of the flocks, which are held there by an excess of oil. As the coating

of flocks on the blade becomes thicker they come in contact with the cloth, which becomes streaked with oil at the point of contact. For this reason the ledger blade should be kept clean. The reverse holds good with regard to the revolver, for the flocks gathered there retain the oil and prevent its reaching the ledger in sufficient quantities to cause trouble. As a proof of this, it has been found by investigation that in mills where the trouble occurred to the greatest extent it was the custom to clean thoroughly every part of the shear once a week.

Brushes. The *setting of the brushes* governs to a great extent the operation of the blades, and incidentally the quality of the work produced. The raising brush especially should be considered. On the first run it should be so set off from the cloth as to just lightly raise the nap, thus preventing the overcrowding of the blades. As the goods are sheared down, the brush is set up a little closer, until when the last notch is turned down on the blades, the brush is set to bring up the last fibres. It makes a great difference in the appearance of the cloth whether or not this is done, especially on face goods. When the cloth is being sheared more closely on one edge than on the other and the blades are found to be in good condition, it will be found on testing that the raising brush is bearing unevenly. To test this, slip off the driving belt of the brush, turn the brush by hand a few revolutions, and then start up the cloth a few inches ahead of the mark left by turning the brush. Any irregularity of setting will then become apparent by the nap. Unevenness of the brush itself will cause the same trouble, and the only remedy is to have it evened up.

The *back brush* should not be set on too hard or it will take off more than is intended. This brush is for the purpose of removing flocks and flyings which may have gathered on the back of the goods, and which if allowed to remain would cause holes to be cut in the cloth when passing over the rest. For this reason the back brush should be set to bear lightly. Too close setting will cause the brush to remove other fibres which are not as solid on the back as on the face, thus quickly filling the flock pan. Unless this is kept cleaned out the brush will carry the flocks around and back onto the cloth, resulting in flock holes when the cloth reaches the rest. Greasy flocks dropping on the

brushes often cause bad streaks, and should be avoided. During the grinding the brushes should be well protected from the flying oil and emery. All the brushes should be turned end for end at least once in two months to insure even wearing, and they should be thoroughly cleaned at least once a week.

Rubber Rest Shear. The latest and most improved type of shearing machine is the rubber rest shear, as illustrated in Fig. 48. As may be easily noticed it does not differ radically from the ordinary type in the running parts other than in the cutting arrangements. Fig. 49 shows the manner of operating the cutting part by means of a lever, including the frame in which the revolver box is set. The journal box consists of one piece, which is slipped over the revolver shaft, and held in its place in the frame by means of the cap on top. A sectional view of the cutting arrangement is given in Fig. 50, showing clearly the way in which the revolver comes in contact with the ledger blade. The tube A, as shown, is laid in the groove of the rest and held firmly in place by the apron C, tracing cloth being the best fabric for this purpose. The broken line B, shows the threading of the cloth to be sheared.

Cutting Mechanism. On the examination of the cutting arrangement it will be found to differ materially from what has already been described. The principles remain the same, but there is quite a departure in the method of application, requiring a consequent amount of study. One of the differences which first becomes apparent is the relative position of the blades. The knives of the revolver on the ordinary shear come in contact with the ledger blade at an angle of about 45°, but on the rubber rest shear the revolver knives strike the ledger almost at *right angles*, thus bringing the revolver on top of the goods. This is made necessary by the use of the rubber tube, because with the blades in the same position as in the ordinary shear it would be found impossible to set them in close enough to do any shearing.

There is a great deal of difference between the plain rest and the list-saving rest on ordinary shears as to close shearing; the goods being cleared out more readily on a plain rest. The reason is that the plain rest being sharper, opens the twill better, and the fibres between the twills stand out straight and are easily sheared off. On the list-saving rest, which is not so sharp, the twill is not

opened out to the same extent and many fibres are held down, making it necessary to let the blades down lower, and give more runs to produce equal results. This same difference is found on the rubber rest shear to a more marked degree, requiring the

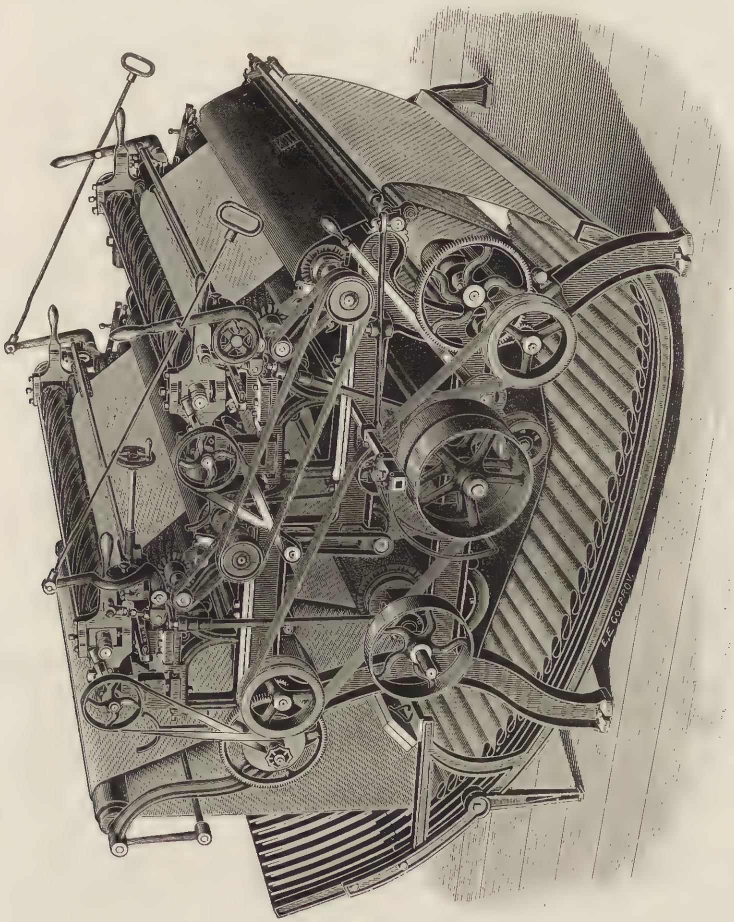


Fig. 48. Double Shear.

blades to be let down to a point much lower than would be deemed advisable on an ordinary shear.

Another noticeable difference between the cutting arrangement of the rubber rest shear and that of the ordinary shear is in the number of knives comprising the revolver. The ordinary revolver contains from twenty to twenty-six knives, while the re-

volver used in connection with the rubber rest has but eight knives. The latter, however, is run at a speed of 1,400 revolutions per minute, as compared with a speed of from 800 to 900 revolutions per minute on the ordinary revolver. While in some places this type of shear has been condemned because of producing an excessive amount of damaged work, it will be found on investigation that such trouble has been due to incorrect handling. On close finished goods for men's wear, especially worsteds, its value becomes readily apparent, and for ladies' dress goods it is beyond question the most efficient machine.

Damage may result from one or more of several sources, but is usually due to incorrect setting of the blades, faulty working of the friction take-up, or a combination of the two. If the blades are correctly set and the other parts as they should be, damage is the result of gross carelessness in operation.

Adjustment. The arrangement for raising the blades, by means of a lever on either side, may cause trouble to the shearer at first, but continued use will remove this. The carriage can be adjusted in any direction by means of screws at either side. The rest also may be tipped to suit requirements, but it is well to change this only when absolutely necessary. The blades coming down on the goods instead of partially sideways makes the danger from the revolver striking the goods much greater, and the damage resulting would be greater than on an ordinary shear. Many finishers set the blades so that when the last notches are turned down there is a slight tremble or jar to the cloth, caused by the revolver striking it. This practice is to be discouraged, however, as it is inadvisable to have the revolver come in contact with the goods. This is especially true in the case of a rubber rest shear, such setting being almost certain to result in damage, for which the blame is often laid to the tube. The edge of the ledger blade should be set to the center line which is marked on the journal box frame at each end, and be kept as near that line as possible. Occasional honing will wear the edge back, but the distance should not be allowed to exceed $\frac{1}{32}$ of an inch. The revolver is arranged so that it may be raised out of the way to facilitate handling the ledger.

To *set the revolver* turn down the notches until it comes in contact with the tube, and by means of the adjusting screws

set it directly above the center of the tube. If the revolver is set too far forward, with the ledger in its proper place, any bunches or knots which come up do not have sufficient time to become buried in the tube, and are consequently gouged out, leaving holes. Holes are also caused by the formation of small blisters, which are cut in the same manner. On the other hand, if the blade is set so as to be back of the center or highest point of the tube damage is sure to result, whether or not there are slugs and bunches in the goods. The best results in every way are obtained by adjusting

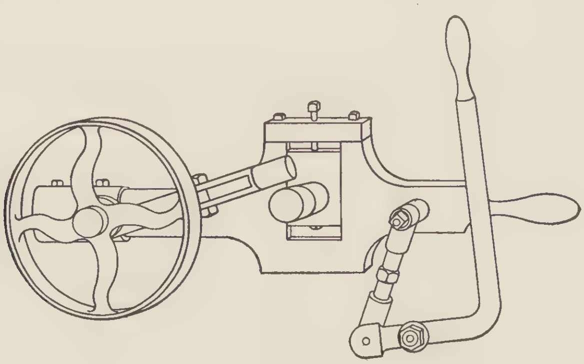


Fig. 49. Operating Lever.

the ledger to the center line of the revolver, then drawing the revolver slightly away from the heel of the blade, and setting the carriage so as to have the cutting done at the highest point of the tube. Keeping the take-up friction clean and properly adjusted will obviate any difficulty arising from that source.

Tension. Incorrect adjustment of the tension is almost as prolific a source of trouble, in connection with rubber rest shears, as incorrect blade setting, and a little experimenting is usually necessary before one unaccustomed to the use of these shears may obtain the best results. The goods must be run with rather more tension than the moderate amount found to do the best work on an ordinary shear. This is necessary in order that the knots and bunches may be buried in the tube, to protect them from being gouged out. When the tension is insufficient these knots do not become buried deep enough, and therefore the rubber rest is not allowed to accomplish the purpose for which it is designed. An

excessive amount of tension, however, is equally to be avoided, because under such conditions the tube is flattened so that the sides stand higher than the middle, and if for any reason the list motion acts too slowly, both the tube and apron may be cut. The thinner and smoother the goods, the more care is necessary in shearing them, and the more trouble may be expected.

Care of Rubber Tube. The tracing cloth apron which retains the tube in place is another source of frequent trouble. The constant friction of the goods on this apron causes it to become worn to such an extent that the tube breaks through it, unless the wearing point is changed frequently. When it does break through the result is either a cut or a closely sheared streak, which is almost as bad. Thin goods are usually cut, but men's wear goods being heavier only become sheared closely. To prevent such trouble occurring move the tracing cloth apron about $\frac{1}{2}$ inch as often as a new wearing surface becomes necessary. Moving for each two pieces is often enough for average work, but on hard firmly woven goods with a pronounced twill it is necessary to move it more frequently. In extreme cases it is necessary to move it as often as twice for the same piece.

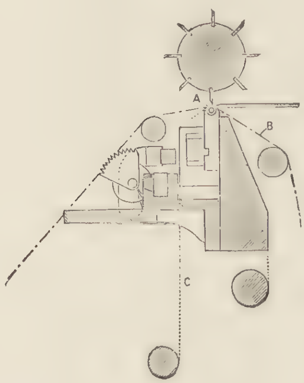


Fig. 50. Rubber Rest.

The apron should be put on squarely, and drawn evenly, so as to compress the tube equally the whole length. If it is a little loose at one side, the tube expands, causing that edge of the cloth to be sheared more closely than the other. As the groove which holds the tube is made of metal it is essential that the tube should be an exact fit, otherwise it will become displaced whenever the apron is moved. One end of it might be at the front side of the groove and the other end at the rear side, making it necessary to test the setting with paper after each change of the apron. In case of absolute necessity a small tube may be used temporarily by the following means: After removing the apron apply a little good glue along the rear side of the groove, replace the tube and

press it against the rear side of the groove. Then let the blades down so as to press lightly upon it and allow to set over night. When the apron is replaced good service may be obtained for some time, but a tube so set is not to be relied upon.

A large tube is even worse than a small one because it has to be compressed into the groove, thus minimizing the cushion-like action which is the reason for its use. *Unevenness in the tube* is corrected by various devices in the different makes of machines. On one make the tube is compressed by decreasing the width of the groove, while on another style the same effect is obtained by means of screws in the bottom of the rest. The greatest amount of trouble found in connection with the tube is caused by oil getting on the ends, and tending to disintegrate and destroy the elasticity of the rubber. For this reason oil should never be used on the list-motion in connection with a rubber rest shear; graphite serving the purpose much better.

Oil is also communicated to the tube by dripping from the journal-boxes onto the list-motion, and therefore the journal-boxes should be wiped off frequently. When a tube does become injured by contact with oil it should be replaced. To do this loosen the apron, draw out the old tube and insert the new one, taking care the groove is free from dust and flocks. Old tubes may be used again by removing the damaged portions and butting two of them together with glue; when they will give results equal to a new tube.

Grinding. Rubber rest shears are ground in a different way than ordinary shears. The construction of the cutting parts is such that instead of drawing up the ledger to the revolver, the revolver is let down to the ledger. Two screws are set in each journal box for this purpose, one on top, and one at the bottom, by the use of which the journal boxes are either raised or lowered. Raise the revolver out of the way by prying up the journal boxes and placing blocks under them, after first removing the box caps. The screw in the bottom of the frame upon which the journal box rests should not be disturbed. When the revolver is raised, clean it thoroughly and adjust the ledger blade to the center line. Then let the revolver down and proceed to grind, using all due precautions to protect the other parts of the machine from the emery and oil mixture. Use No. 120 emery at first, then flour of emery and

finally pure oil. Let the revolver down gradually by withdrawing the bottom adjusting screw and following with the top one. Grind to an edge and hone as in other types of shears.

The arrangement of the cutting parts requires that the ledger should have a long thin bevel, and for this reason the progress of the grinding must be closely watched to prevent too much being ground away. Because of this thinness of blade, the time required for grinding is comparatively short, but the application of oil alone should be lengthened so as to make it very smooth; and honing should take the place of grinding to the greatest possible extent. After grinding set the ledger again and adjust the revolver to it. The revolver is eased away from the heel of the ledger by drawing forward very slightly the frame which carries the journal boxes. To reduce an excessive amount of noise from the blades after grinding, loosen each end screw by which the ledger blade is attached to the bed and insert a strip of thick paper between the blade and bed.

If the foregoing precautions are carefully observed no trouble should be experienced from the rubber rest shear. On the contrary the quality, and on some goods the quantity, of the work done will probably exceed that of an ordinary shear.

A certain amount of study and attention must be devoted to the method of operation by anyone not acquainted with the peculiar construction of this type of machine, if the highest quality of work is desired. The machine should be kept scrupulously clean with the one exception of the revolver, which should be allowed to retain the flocks for reasons fully explained in the description of ordinary shears.

STEAM BRUSHING, DEWING OR DAMPENING.

When the goods have been properly sheared, they are subjected to a *steam brushing.* On face goods this process should not be omitted on any consideration, as it leaves the goods in much better condition for the next process. The ordinary brushing machine with steaming attachment is used for this purpose, and the treatment varies with the goods to be operated upon. While it is in all cases desirable to subject goods to the brushing and

especially the steam brushing process, it is in many places given but scant consideration.

Brushing, at any time, is of decided advantage to the goods, and while it may be deemed advisable to do away with some of it on close finished goods, this should never be attempted on face goods. There is no process so simple as the brushing, and the effect upon the goods is so beneficial that it is a case of mistaken economy to curtail its use. On close finished fabrics, one run with

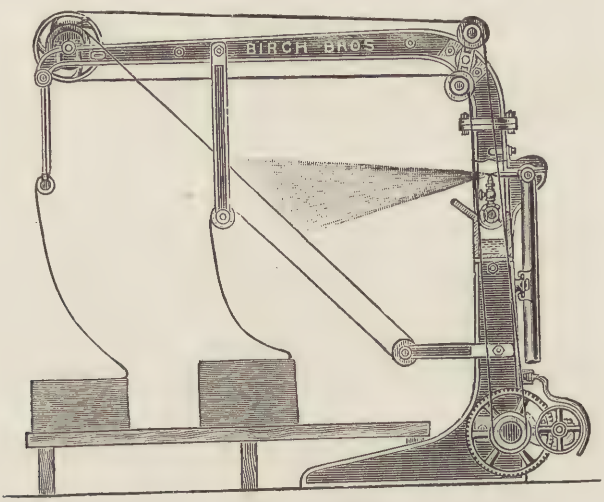


Fig. B. Birch's Dewing Machine.

or without steam will usually answer the purpose; but on face goods at least three or four runs with steam ought to be given.

The latest machines used to prepare goods at this and other stages are the dewing or dampening machines.

Dewing Machines. In finishing woolen goods, they are often subjected to a steaming process while in the dry state. The object of this is to impart a certain amount of moisture. In many cases it would be better to have the moisture supplied in the form of a fine spray of water, as the heat of the steam counteracts to some degree the beneficial effects of the moisture. For this reason dewing machines, which supply the moisture as a fine spray, dew-like in effect, are coming into use more every year. One of the particular uses for these is to dampen the cloth before

pressing, as only by such treatment can the best results be secured; therefore, the chief requirement of such machines is that the moisture be distributed uniformly. In some mills the goods are

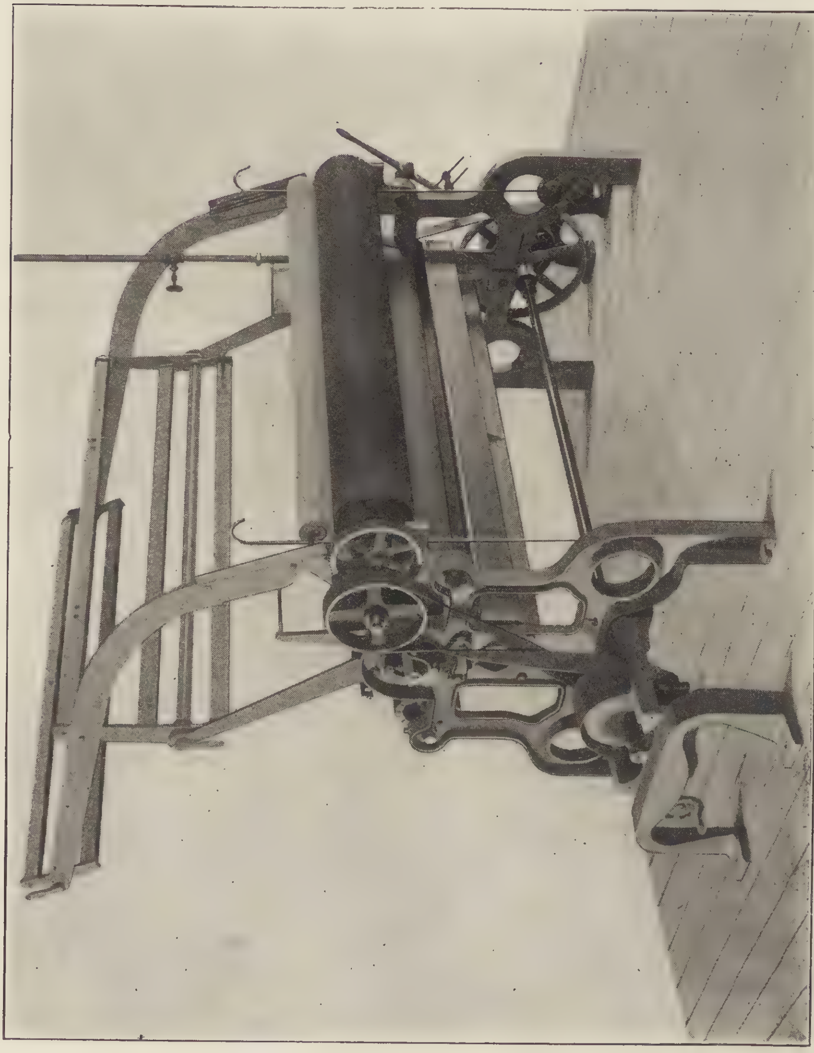


Fig. C. Voelker's Dewing Machine.

sponged so that they may be sent at once to the cutters; and a dewing machine is found to be of special benefit for this purpose. This process removes the press finish and causes the goods to take

the natural shrinkage which always occurs when the tension from pressing, winding, etc., is relieved.

Operation. Fig. B represents a type of dewing machine built by Birch Bros., which has extensive use. The method of operation is shown clearly in the cut. Another and somewhat later type, that of G. W. Voelker, is illustrated in Fig. C, a sec-

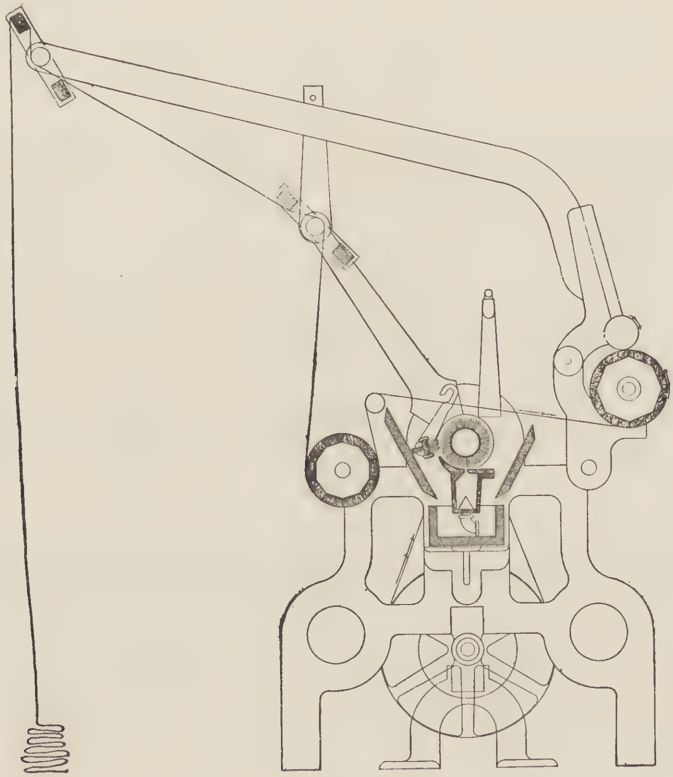
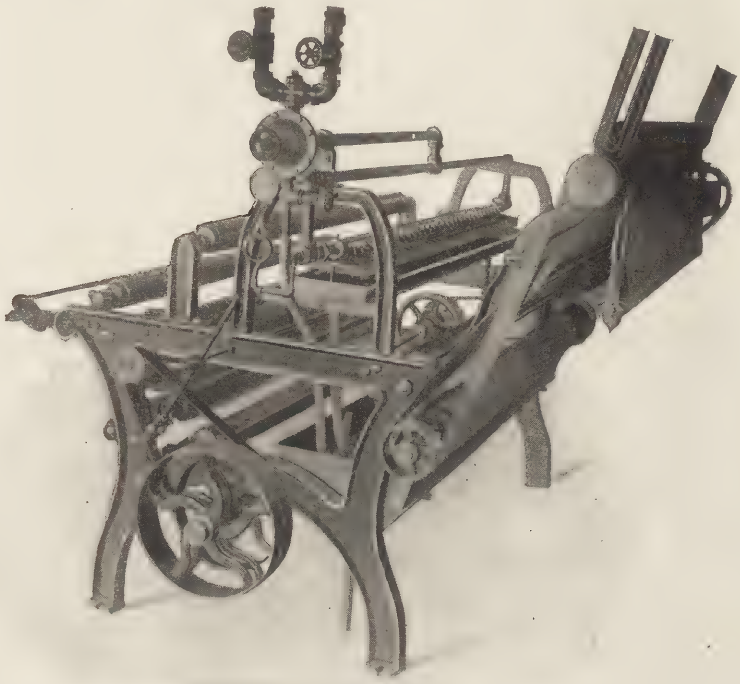


Fig. D. End View of Fig. C.

tion drawing being given at Fig. D. In this machine the water is forced through a pipe, which has a narrow slot in it, onto a rapidly revolving cylinder, the latter being covered with a fillet composed of a rubber foundation with long bronze wire teeth. The water adheres to the teeth as the cylinder revolves until they come in contact with a stationary wire comb fixed on an iron rod, which lies parallel to the cylinder. When the cylinder wires come in

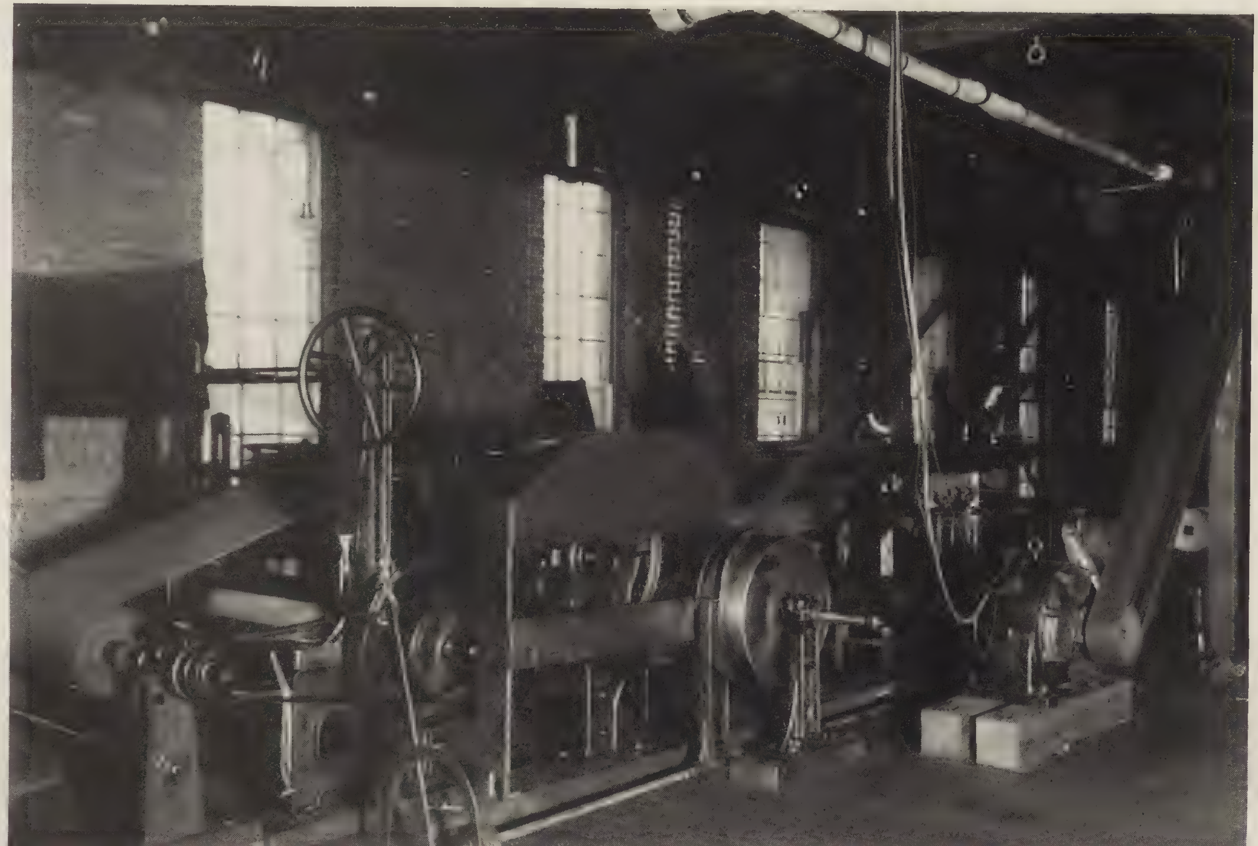
contact with the comb they are caused to vibrate, thus throwing off the water in a finely divided state. This action is facilitated by the air current which is constantly thrown outward by the revolving wires, resulting in a very fine mist. There is no possible chance for drops to get upon the cloth and therefore the dampening is uniform. After dampening, the cloth is wound tightly on wooden rolls to allow the moisture to penetrate thoroughly.



Fig, E. Stiner's Dewing Machine.

Another type of dewing machine, known as Stiner's patent, is shown at Fig. E. The sprinkler arrangement on this machine consists of a brass pipe fitted with a number of small valves, or jets, each of which carries a screw cap with a small perforation.

Should one of these jets become clogged at any time it may be removed and cleaned independently of the others. As the water which is used in the machines is all filtered, there is little chance of the jets becoming clogged at any time.



10 H. P. INDUCTION MOTOR DRIVING TENTER FRAME

United States Finishing Co.

The filter which is attached to the machine, is fitted with a wire brush so arranged that when any sediment collects on the filter screen, the brush may be pushed against the screen, twisted around a few times, causing the sediment to drop into a drip pipe and pass out into the sewer. On the regular size machine the sprinkler attachment has thirty-one jets. Directly under these jets are two deflectors or plates, one a stationary plate of sheet iron, the other a movable plate of brass. Each plate is perforated with thirty-one one-inch holes which come directly under the jets. When the machine is stopped, the streams from the jets pass down through the holes into the drip pan and thence to the sewer. The movable brass plate is so connected to the shipper that when the machine is started it slides over the iron plate far enough to cover the holes, and the streams of water striking it are broken up into fine spray.

Each machine is fitted with a water valve pressure regulator, by means of which the amount of dampness is controlled and any degree of dampness may be obtained. A pressure of at least fifty pounds is required for the successful operation of this machine. In mills where the pressure is not so high, a small rotary pump may be fitted to increase it.

When the goods have been brushed, they are given one run over either of these latter machines, regulating the moisture to suit the requirements. In such cases, the steam at the brushing should be omitted.

PRESSING.

The goods are now subjected to the operation of pressing. While some contend that pressing is the least important of the finishing operations, it cannot be denied that it is a very essential process in producing the fine appearance of a perfectly finished fabric. Of course various notions prevail, and in recent years the pressing has been regulated, to a great extent, by the whims of the buyer and commission merchant. There is also a difference of opinion among finishers, with reference to the methods to be used for different fabrics. Some maintain that finer grades of goods, especially face goods, cannot be properly pressed other than in the old-

fashioned way of using papers. While this is not the case, the practice is still used in some places and a description is necessary.

Paper Pressing. For the purpose of paper pressing, large sheets of a specially finished cardboard, known as press paper, are used. The goods if wide are doubled, the two selvedges being brought together, and then folded nicely, when the papers may be inserted. One man can do this work alone, but it can be done much more economically by two men working together. The piece is laid face up on a long table, and as one man doubles it the other draws it along and folds it. It is then taken to another table upon which is laid a small pile of the papers, and at one end of which two boards are fitted at right angles to form a box corner about ten inches high. This box serves as a guide in building up the piece which is papered as follows: A sheet of paper is laid in the corner with the pile of papers next to it, and the folded piece, with number end and list toward the operator, is placed next to the pile of papers and slides over it into the box. The end is then laid upon the sheet of press paper, a second sheet being inserted in the fold, and a third laid on top. A fourth sheet is inserted in the fold, and the edge brought up even with the edge of the second sheet, when the cloth, together with a sheet from the pile, is folded over into the box. A fifth sheet is inserted in the fold thus brought on top, and a sixth is laid on top, the cloth being again folded over. This operation is continued until the piece is all papered, care being taken that it is folded so as to make a straight, even pile. It will be noticed that the cloth does not come in contact with itself either on *face or back*, the paper being between every two thicknesses.

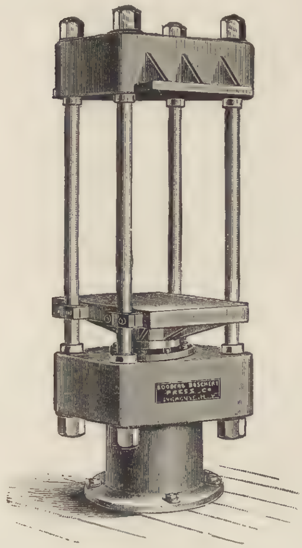


Fig. 51. Hydraulic Press.

When a number of pieces sufficient to fill the press have been thus papered, they are placed in the press in the following manner: Two iron plates which have been heated are placed in the press,

then a sheet of cardboard, and the piece of cloth with another sheet of cardboard on top. The press is filled in this way, the heated plates, cardboard, cloth, and cardboard being placed in regular rotation, finishing with the hot plates. The press is then screwed down or, if hydraulic, pumped up to the pressure required, and allowed to remain over night, or for about twelve hours. Then the pieces are taken out and the papers changed so as to have the portions of the cloth which were not pressed in the first operation come in the middle of the sheets. A second pressing of the same duration as the first is now given the pieces, after which the papers are removed and the fabric is ready for the next operation. With the double handling required, it is a good day's work for two men to press twenty pieces. Figs. 51 and 52 represent presses used for paper pressing. These are built by the Boomer and Boschert Press Co., of Syracuse, N. Y., one being hydraulic and one power.

Rotary Presses. In pressing cloth with a *rotary press* it is subjected to heavy pressure between an iron cylinder and one or more press beds, both the cylinder and beds being kept heated with live steam. The cylinder and beds should be made of fine grained cast iron, ground perfectly true and with a uniform thickness of shell. If the thickness varies, the expansion from the heat is unequal and the pressure will not be uniform. The cylinder must be draw-filed lengthwise to prevent the cloth from slipping as it revolves. Most styles of press beds are planed so as to fit concentric with the cylinder, and all are faced with highly polished brass to allow the cloth easy passage under pressure. These brass jackets are fitted very tightly over the edges so that no dust, flocks, etc., can work in between them and the beds proper.

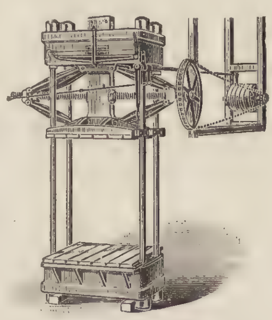


Fig. 52. Power Press.

The above requirements are true of all rotary presses, but are met in various ways by the different builders as will be evidenced by the following descriptions.

Construction. The first style of rotary press to demand attention is the Old Gessner press. This style was first introduced

in 1878 and is still giving satisfaction, being used to some extent in preference to later and more improved models. Fig. 53 is a sectional view of this machine, the course of the cloth being shown by the dot and dash line. The main parts are a $12\frac{1}{2}$-inch cylinder C, two heavy press beds M and M^1; two brushes Z and A; rolling and folding attachments; pressure gauge; steam gauge, and piping. The cylinder C runs in boxes on the center or main frame of the machine, being driven through the train of speed-reducing gears shown by the dotted lines *z*, Z, V, and R, in Fig. 53. By using this system of gearing a comparatively small amount of power is required. The heavy press beds M, M^1 are mounted on the upright wings W, W^1, which are pivoted at the bottom and connected at the top by powerful coil springs F and F^1. These springs have nuts Q fitted on the front ends, with worm gear nuts H at the opposite ends, the latter being actuated by worms on a worm shaft to which is fixed the handwheel I. By turning the handwheel I, the wings W W^1 are either drawn together or spread apart, thus causing the press beds to press against the cylinder or to be drawn away from it. The springs F F^1 give sufficiently to relieve the crushing pressure which would otherwise be exerted. The press beds are self adjusting on their bearings so as to give a uniform circumferential pressure, and are also provided with heavy truss rods B B^1 with nuts on the ends and set screws *d* and d^1 in the center, by adjustment of which equal pressure is insured all across the cylinder. A pressure gauge, consisting of a numbered dial and pointer, is actuated by turning the handwheel.

Operation. As various fabrics require different degrees of pressure to obtain the desired effects, it is well to keep a memorandum of the number registered for any particular fabric or effect, in order that the same effect may be obtained subsequently without experimenting. The course of the cloth through the machine, as indicated in the cut by the dot and dash lines, is in detail as follows: From the platform at the front of the machine it passes over the brush regulator *o*, around a beam to a second brush regulator *f*, one side being brushed by brush Z and the other by brush A. The amount of contact with the brushes is regulated by the handwheels L and L^1 through the worms and worm gears. Then from regulator *f* it passes over the carrier roll D, around the friction

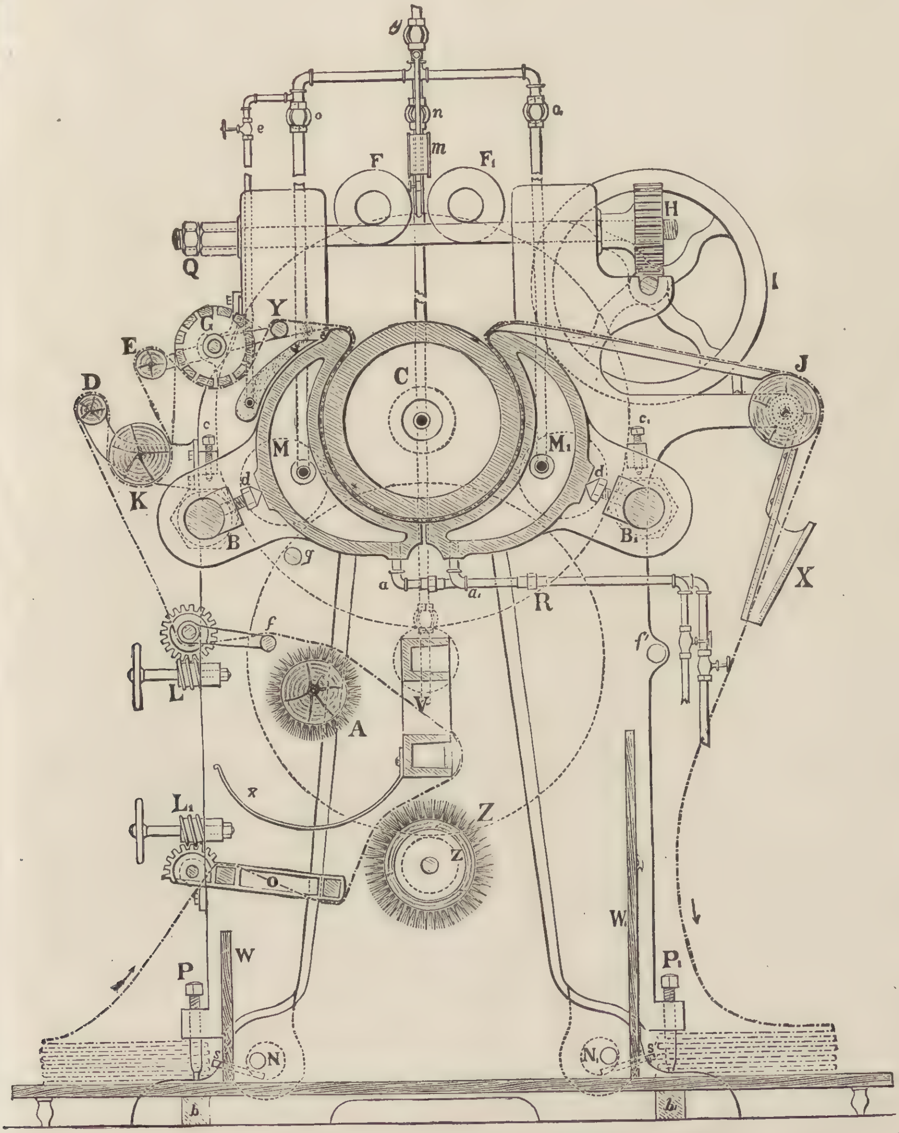


Fig. 53. End View of Old Gessner Press.

roll K, which has a friction clamp at one end, to the stretch roll G, where it is spread out to full width, and over the steamer to the press beds and cylinder. The steamer is for the purpose of applying steam to such goods as it is considered advisable to so treat before pressing. Passing between the press beds and cylinder the cloth is pressed and taken up by the draft roll J, from which it is either rolled up or folded onto the platform below.

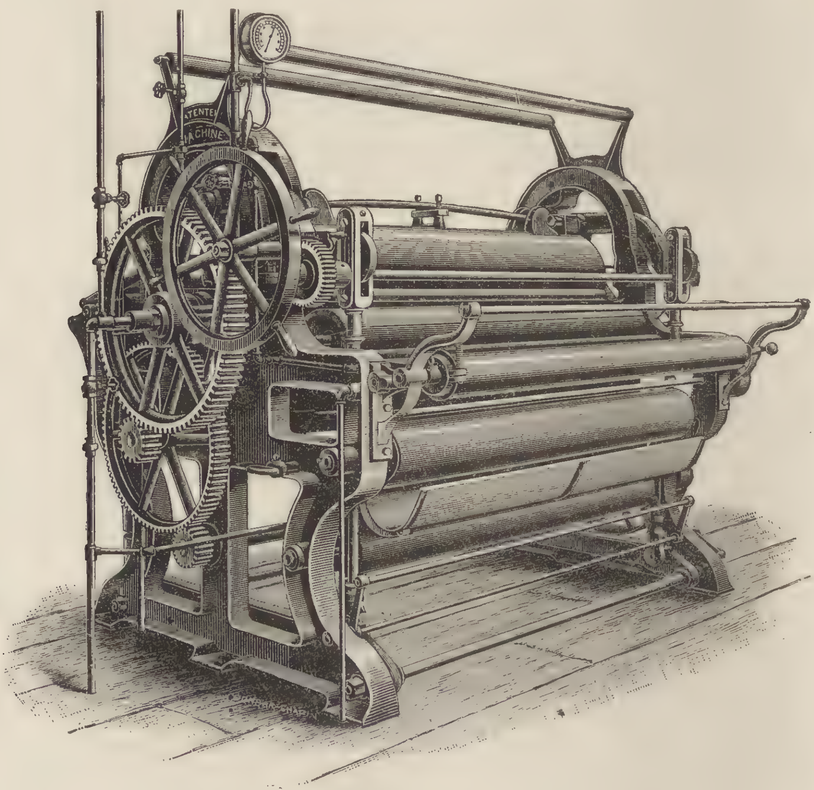


Fig. 51. Woonsocket Machine Press Co.'s Miller Press.

The *pressing surfaces* of the beds are covered with brass jackets and the machine should never be run without cloth between the beds and cylinder, because there is always sufficient contact to wear the jackets. A leader should always be kept on the press to prevent such happening, as well as to save time in starting up. Allow the press to become thoroughly heated before

starting up, with the gauge registering at least 40 lbs. of steam, and apply the beds very hard in operation. The best and most permanent results are obtained by hard pressing with the press heated thoroughly, and regulating the finish by means of the steam brush. In this way a finish may be obtained which will compare favorably with results produced by any other method.

Various Types. Another type of rotary press is the one known as the Miller press, of which a front view is illustrated at Fig. 54. From this cut it is readily seen that the construction differs materially from that of the Old Gessner machine. Of course the

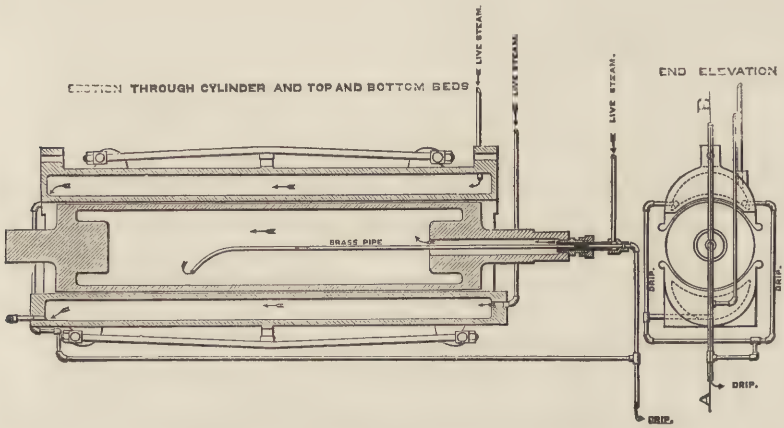


Fig. 55. Steam Connections of Miller Press.

principle of operation is the same and the pressing surfaces differ very little, but the beds enclose the cylinder from top and bottom, instead of from the sides. Instead of moving the beds up to and away from the cylinder, the bottom bed is fixed and the top bed and cylinder are lifted. This is accomplished by means of a large handwheel which, through the connections of levers and cams, lifts first the top bed and then the cylinder. The pressure is applied by a system of weights and levers, and the amount of weight applied at each end is equalized by screwing in the lever rods. When the levers are unweighted, the pressure is about 4,000 lbs., and by adding weights it may be increased to 10,000 lbs., as follows: With No. 1 weight the pressure is increased to 5,400 lbs.; with No. 1 and No. 2, to 6,440 lbs.; with No. 1, No. 2, and No.

3, to 8,000 lbs.; and with No. 1, No. 2, No. 3, and No. 4, to 10,000 lbs. Fig. 55 shows the steam pipe connections and is self-explanatory.

An end view of the press bed is presented in Fig. 56, while Fig. 57 is an end view of the machine which gives a good idea of the travel of the cloth. The cloth, entering between the bottom bed and cylinder, is carried around by the cylinder under the top bed, from which it passes over the two idle rolls above the press bed, down under an idle roll at the back of the machine, and to the cloth roll, to be either rolled up or folded onto the platform beneath. Figs. 58 and 59 show the manner of driving the brushes, the usual method being as in Fig. 58. On certain classes of goods, where it is desirable to have the nap lie in the direction in which the goods are moving, the brush is run as at Fig. 59. Cassimeres are sometimes run in this way when it is desired that the nap shall have little or no springy feel; the pieces being run in tail end first, and the nap laid in the right direction when it comes in contact with the cylinder.

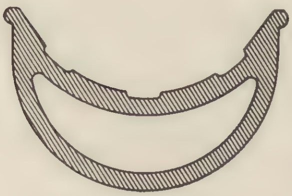


Fig. 56. End View of Press Bed.

New Century Press. One of the latest and most improved types of rotary press, built by David Gessner, of Worcester, Mass., and known as the New Century Press, is illustrated in Fig. 60. Referring to Fig. 61, the passage of the cloth through the machine is indicated by the dotted lines. From the floor in front of the platform E, it passes over the rod 1, down under the platform, being guided by the idle rolls 2, 3, and 4; up over the finger rod 5, around rock shafts 6 and 11, one side being brushed between these two points by the brush 7, the other side receiving a brushing from brush 12, after which it passes around the friction roll 13, under roll 16 to the spreader roll 17, and over the steamer 18, between press beds B and B' and the cylinder C, from which the draft roll 20 takes it up, it then being wound into a roll or passed through the folder 21 to the floor.

Operation. The contact of the cloth with the brush 7 is regulated by changing the meshing of the teeth of the ball-handle arm 10, with the segment 9, which is cast in one piece with the

swing-finger arm 9 *a*. To do this, disengage the teeth by lifting up the ball-handle arm until it is out of contact, and then remesh to suit the required conditions. A spring is provided to hold the ball-handle arm in mesh, acting from above where it is located in the small housing 10, which is attached to the front upright D. Changing ball-handle arm 25 in the same manner regulates the contact with brush 12. The flocks from brush 7 strike against a

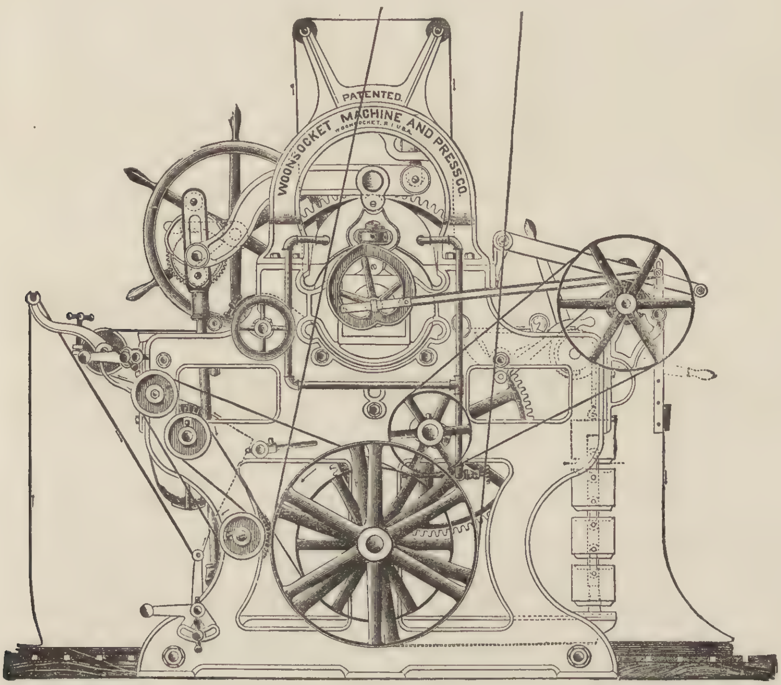


Fig. 57. End View Miller Press.

dashboard 8 and fall to the floor, while those from brush 12 fall into box 14, to be removed through a door in front.

The *amount of friction* to which the cloth is subjected is regulated at two places. First by means of a friction clamp 15, gripping a small pulley on the end of the roll 13, and secondly by a weighted strap 16 *a* (Fig. 62), which is mounted on an extension of the stretch roll bracket 17 *a*, and slipped around a small pulley on the end of roll 16. Pressure is applied by turning the power shaft *k*, to which is keyed the toggle *f*, thus changing from the

position of no pressure, illustrated in Fig. 61, to the position of full pressure shown in Fig. 62.

Referring again to Fig. 62, the operation of the parts may be described in detail as follows. The power arm *m* is pivotally connected to the screw-threaded connecting link *n*, which, passing through the sleeve on top of the rear upright D′, is held in place by the collar *l* on one side, and on the other side by the worm wheel *o*, which is threaded on the link. A worm *h*, meshing into the worm wheel *o*, is keyed on the worm shaft *p*, which carries at its end a

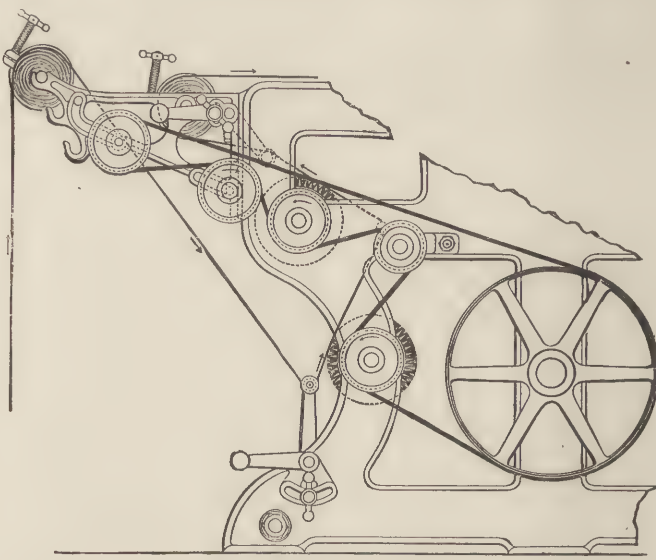


Fig. 58. Brush Belting.

small handwheel *q*. By turning this handwheel when the pressure is let off, the screw link is taken up or let back, thus shortening or lengthening the connections. Hence the amount of pressure applied by turning the shaft *k* over into its locked or pressing position, is increased or diminished, according as to whether the worm-gear *o* is tightened or loosened. When the shaft *k* is turned backward one-half revolution, the beds B and B^1 are immediately thrown wide open, out of contact with the cylinder as in Fig. 61, all pressure then being removed. In order to equalize the backward tilt of the uprights D and D^1, when releasing the pressure, they are pivotally connected by arms *r* and r^1 to the swing pieces

s which are loosely mounted on pivots attached to the main frames A. These connections also serve to keep the uprights in their positions in case it is necessary to remove the cylinder. Should this ever be necessary, first disconnect the steam piping, then withdraw the shackle pins n', thus breaking the connection between the power arm m, and the screw link n, and allowing the uprights to fall back until held by the arms r and r'. This leaves, after swinging the power arms m out of the way, an open space for the removal of the cylinder. Stops t and t' are provided to prevent

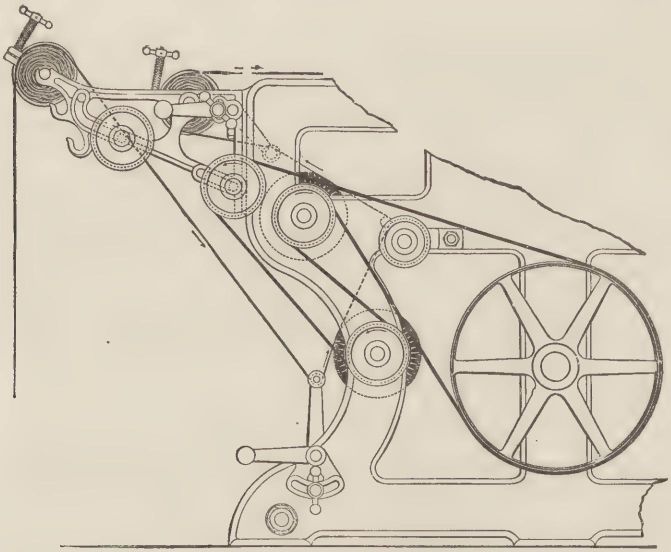


Fig. 59. Brush Belting.

arms r and r', from turning too far. The beds B and B′ (Fig. 61) carry on the lower corners at one end the idle rolls b and b', these resting upon the inclined surfaces g and g', which are cast in one piece with the girder G. This girder G unites the main supports A; the girders F and F′ serving the same purpose at the bottom.

In order to facilitate the application and release of pressure, the power shaft k is driven through a train of compound gears on the outside of the frame, the smallest of which carries a handwheel. The beds are locked in place regardless of the pressure by revolving the shaft until the toggles f are carried slightly below the center.

A sliding coupling *v*, held in place by a screw button, connects the two sections into which screw shaft *p*, is divided. To adjust the pressure at one end without disturbing the other, it is only necessary to loosen the bottom and slip the coupling aside, when either section of the shaft may be turned independently, each revolution advancing the worm wheel *o* just one tooth. In this way the pressure is most accurately adjusted without the use of a wrench.

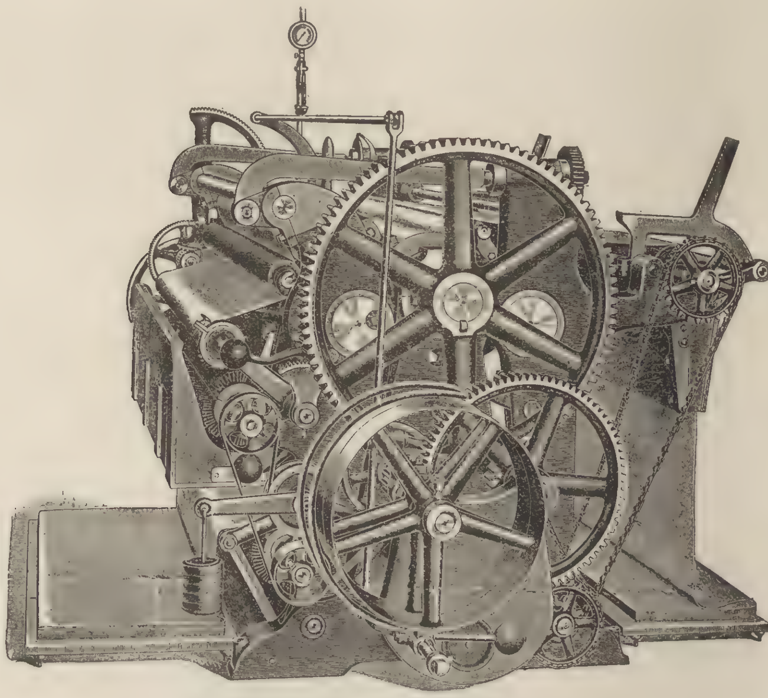


Fig. 60. New Century Press.

When the *coupling is reset* the shaft again becomes as one piece, and is then subject to action at both ends simultaneously by use of the handwheel *q*. A dial *x* having numbers facing toward both the front and the back, registers each adjustment by means of an indicator *y* attached to the back upright D′, which shows amount of change in pressure. The trusses fitted to the bed plates are of an improved type fitted with double-threaded screws by the adjustment of which uniform pressure is insured. These truss screws *z* and *z′* are double acting, one end engaging in

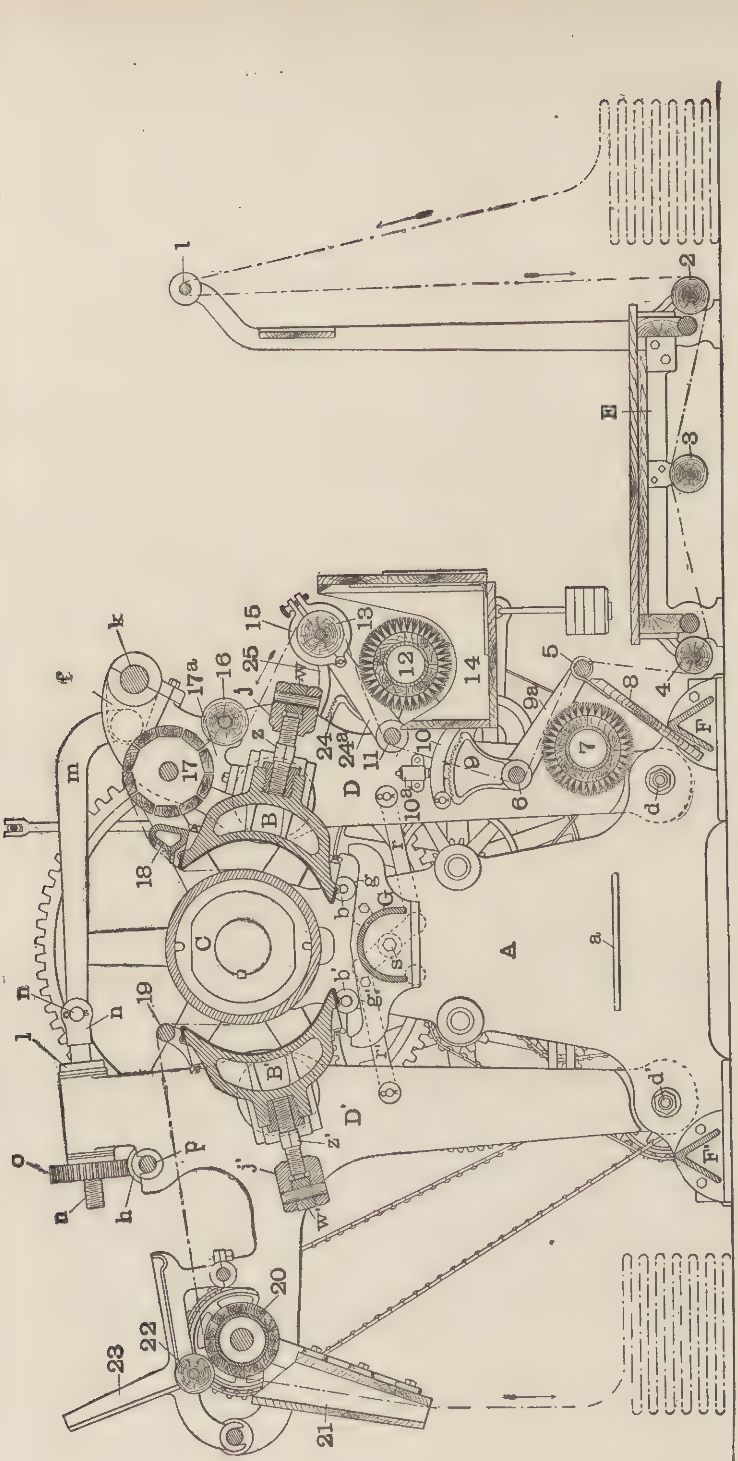


Fig. 61. Cross Section of New Century Press. Pressure Off.

the back of the beds, the other in the shackles j and j' which connect the truss bars w and w', and by turning the screws in the required direction the middle of the beds are either drawn away from or applied more forcibly to the cylinder. One-sided wearing of the brushes is avoided by turning them end for end in their bearings, or when feasible by reversing the direction of the drive.

Steaming. While these presses are not generally fitted with apparatus for steaming the goods after pressing, they may be fitted with a steaming attachment as illustrated in Fig. 63. By this means the cloth may be steamed on either side as required, the threading for one side being shown in Fig. 63, and for the other side as shown in the small figure at the left. Arranged as in the small figure, the side which in pressing was next the beds is subjected to the steam, while as in Fig. 63 the reverse side is steamed. Fig. 63 also shows how the cloth is wound on wooden rolls either after being steamed, or direct from the press beds over roll 19. The back delivery roll 20 has attached next to it brackets 23 with inclined tracks upon which the wooden roll 22 is placed; the cloth being wound around this as shown.

Voelker Press. Still another press merits description, one which on close examination will be found to have points of exceptional value. This is the press built by G. W. Voelker, of Woonsocket, R. I. A sectional end view is presented in Fig. 64 showing the threading of the cloth through the machine. This is sufficiently plain as to require no detailed explanation.

It is principally in the construction of the beds that this type of machine differs from those previously described. By referring to Fig. 65, it will be seen that the pressing surface of the beds is not planed concentric with the cylinder, but rather in two intersecting arcs of greater radius. The pressing contacts are thereby doubled in number, the cloth being pressed twice under each bed, or four times in passing through the machine. In Fig. 66 the construction of the beds is illustrated more fully. A radical departure has been made at this point by having the pressure from the truss rod applied at the quarters instead of in the center of the bed as is the general practice. The two sections of the rod are pivoted at the extreme opposite ends and passing over the bed plungers are connected by a turnbuckle in the center where adjust-

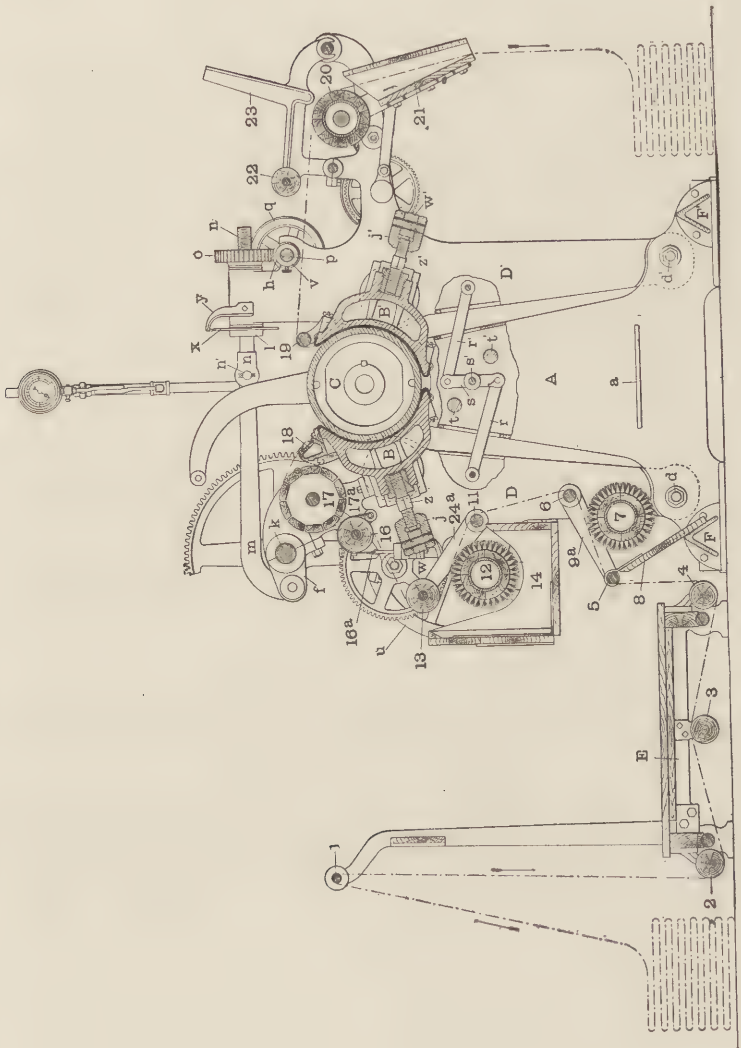


Fig. 62. Cross Section of New Century Press. Pressure On.

ment is easily made. When adjusted this bed is sure to maintain its straightness under any conditions of pressure, and heat, and the cloth will be pressed uniformly the whole width. The cylinder head is bolted in, and the fact that it is built in this way insures an even thickness of metal with uniform expansion when heated.

Figs. 67 and 68 show the various frames and toggle links employed in producing the pressure, a cam being used to straighten out the links. One of the beds is held rigidly stationary, and in applying the pressure the other bed is forced against the cylinder, which is not held in a bearing; this in turn being forced against the rigid bed.

Treatment. It matters not which of these presses is used to produce the effects desired, as the principles are the same in all, the difference coming in the application. The various styles of fabrics require different treatment in pressing according to the effect desired to be produced. On cassimeres, worsteds, and similar classes of goods, it is not desirable to have any lustre on the face of the cloth, therefore these goods must be run with the face next to the cylinder. By doing this the face will move with the cylinder and the back rubbing against the brass jackets of the bed plates will acquire the press glaze produced in pressing. This is also necessary with fancy goods where the pattern is partially composed of raised threads which might be injured if subjected to the rubbing action against the jackets. On the other hand, if it is desired to develop the lustre of the fibre to its fullest extent, as on face goods, they are run with the face down so that it will be subject to the rubbing against the brass jackets, and this in conjunction with the heat will materially increase the lustre on the face of the goods. When running the goods face down, care must be taken to have them run under the stretch roll instead of over it as when pressing the goods face up, otherwise the nap on the surface will be disturbed by the stretching.

Care of Press. The pressing process, consisting only in the application of heat and pressure, is very simple, but there are many conditions governing the most efficient operation of the press. Sometimes it happens that some small object gets on or under the jacket and causes streaks in the goods during the pressing. In

SECTION OF HYDRAULIC PRESS ROOM
Firth & Foster Co.

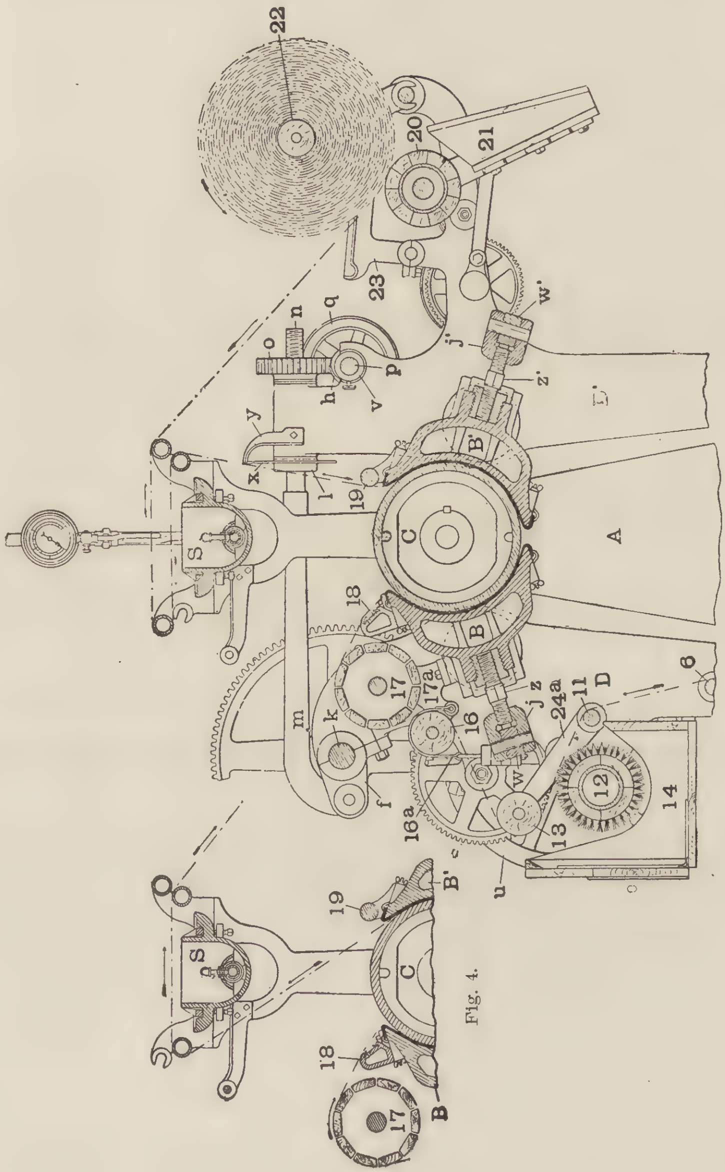


Fig. 63. Steaming Attachment.

such cases it is necessary to remove the jacket and attend to the defect.

To remove the jacket from the Old Gessner press proceed as follows: Draw out all the screws in the bottom of the wings about $\frac{3}{4}$ inch from the feet of the standards, so as to support the wings when opened out and yet prevent them from opening out too far. Disconnect all the brass unions to the steam piping on both beds

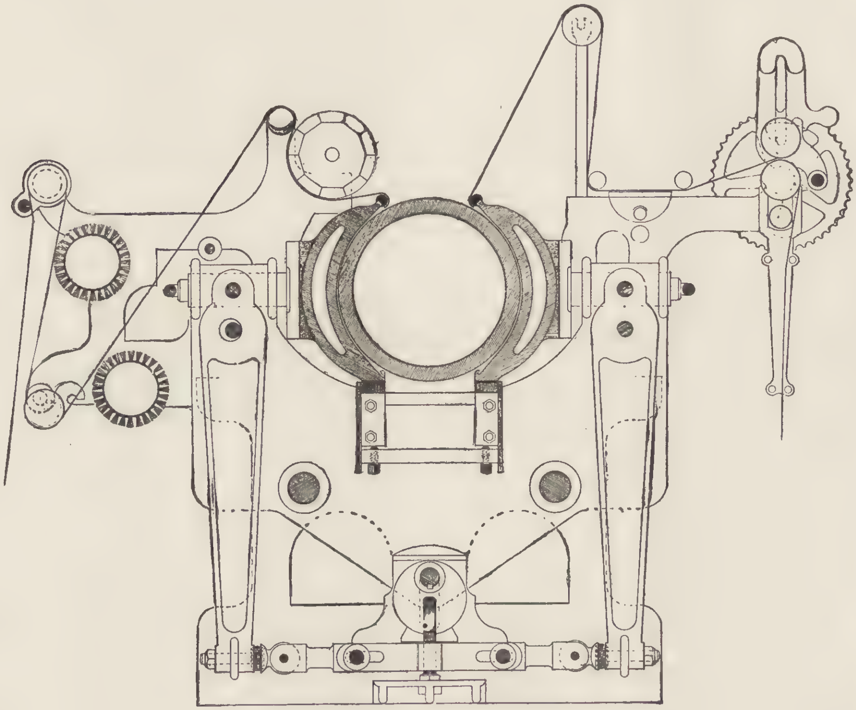


Fig. 64. End View Voelker Press.

and cylinder; remove the chain belt and the belt on the brushes; run the worm gears on the coil springs back until quite loose; take out the screws which hold the jacket; run off the nuts from the coil springs, after first marking their positions so as to replace correctly, and then spread the beds apart until they are between two and three inches apart at the bottom. Now wind a piece of cloth around the cylinder and roll out the jacket toward the back. The jacket now being removed, may be cleaned and repaired as necessary and re-

placed when in proper condition, care being taken that no foreign material is between it and the bed, and the machine may be connected up again as before. New jackets are put in by the same method.

Removing the jackets from the Miller press, which has a jacket for each bed, is made much simpler by the construction. Each bed has a rounded surface over which the jackets fit and are held in place, being held from slipping sideways by means of screws in the middle. When these screws are removed the jackets may be pulled out through the openings after first removing the driving belts. Jackets which have become worn should be sent to the makers, who re-roll them so that the reverse side may be used.

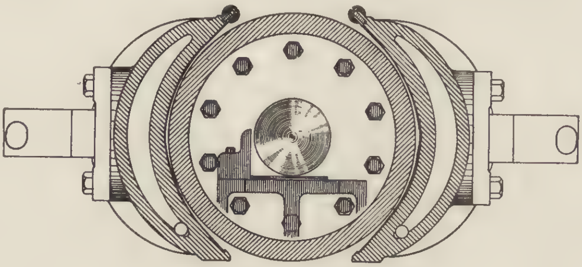


Fig. 65. End View Cylinder and Beds.

On the New Century press the removal of the jackets is as simple as from the Miller press.

When the cylinder fails to pull the goods through evenly, causing them to wrinkle and pull out of shape, it is usually due to the surface of the cylinder becoming glazed or gummy from the dyestuffs or other substances in the goods. This condition is remedied by the application of acid, which will clean and rust the cylinder. When the cylinder is excessively gummy, it should be washed off thoroughly with an alkaline solution before the acid is used. If the cylinder has become worn smooth by long continued use, it should be drawfiled with a coarse bastard file before the application of acid. It is necessary to remove the jacket from the Old Gessner press before this treatment, and to protect the other parts of the machine from being injured by the acid, old bagging, etc., sufficing very well for this purpose. Then if drawfiling is necessary it should be done by an experienced mechanic,

the file being drawn lengthwise of the cylinder; the file marks so produced give the required roughness to the surface. Drawfiling is not a necessary operation as a general rule, a simple rusting, or

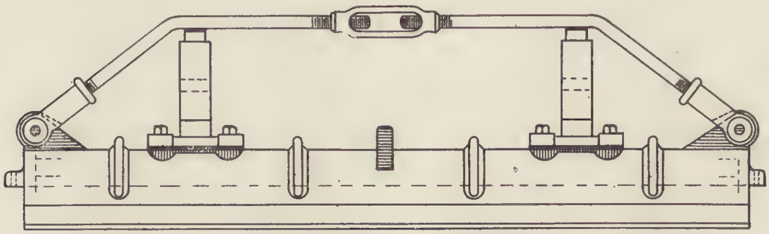


Fig. 66. Truss Rod.

souring, as it is sometimes called, usually being sufficient to make the cylinder do its work properly for a long time.

Rusting or *souring* is accomplished by wetting the cylinder thoroughly, with either sulphuric or muriatic acid diluted with an

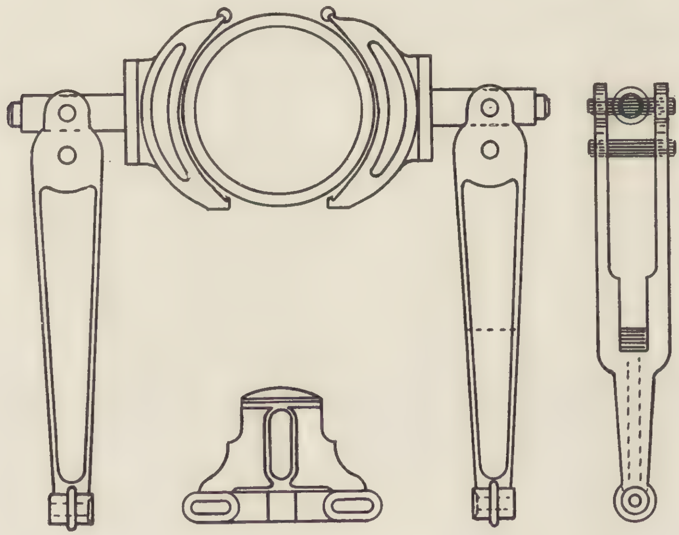


Fig. 67. Toggle Links.

equal amount of water, and allowing it to remain wet for an hour. Two applications of acid are usually sufficient, and then the cylinder is washed several times with water so as to remove every trace of acid. Removal of the jackets is not necessary on the

Miller press or New Century press when souring or draw-filing, but the parts of the machine should be protected as previously described, and muriatic acid should be used, as it does not have an injurious effect on the brass jackets. It frequently happens that the goods do not run through the machine as smoothly as they should because of impurities contained in them; for this reason they should be thoroughly washed. Certain colors in piece-dyed goods are often the cause of imperfect work on the press, particu-

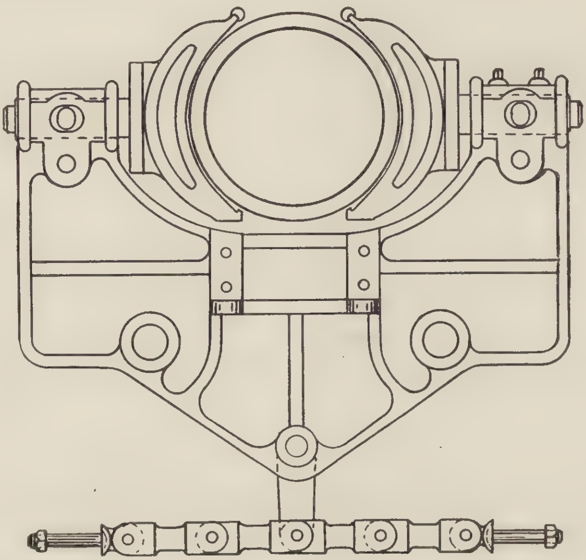


Fig. 68. Toggle Links.

larly if there is an excess of dye grease left in them, which, when subjected to heat, renders them sticky, and thus prevents them from running through readily. When care is taken that the goods are clean and the machine level, with cylinder and jackets in good order, the goods will generally run through easily and the results will be satisfactory in every way.

Steaming Attachments for steaming the goods on the press after pressing, are used chiefly on the cheaper grades of goods, and are designed to produce the required finish without steam brushing. This of course reduces the labor cost appreciably, and the desire to do this has stimulated the builders to improve their ma-

chines in other ways as well; but the finish produced entirely on the press is always inferior. When the goods are finished entirely on the press, it stands to reason that the pressing cannot be as hard as it should be to give a lasting finish, and the results will not equal those produced by hard pressing combined with steam brushing. The cost of finishing in this way is of necessity higher, but the finish is so superior as to be noticeable even to one not familiar with the work. In small mills where the pressing operation does not take up all the time, the goods, by a judicious division of work, may be pressed and steam-brushed without any material increase in the labor cost. Steam brushing or dewing is an indispensable operation when the goods are pressed by the old-fashioned paper pressing.

FINAL INSPECTION.

After steam brushing or dewing, which completes the finishing process proper, it only remains for the goods to be *finally inspected*, *measured*, and *rolled*. The final inspection discloses the result of the previous processes, and even when the finisher is not required to do this, he should examine the goods at this stage; as by using good judgment he, more than any one else, can see how and where any improvement may be made. As this final inspection must be as thorough as possible a sufficient amount of time should be allowed the inspector for the purpose. Any imperfection overlooked here is sure to come up later in a claim from the buyer, who subjects the goods to a very rigorous inspection. If it pays the buyer to have the goods thoroughly inspected to the extent of paying high wages, it ought to doubly pay the manufacturer. The inspector does not rectify faults, but marks them by inserting a string in the selvedge. Each string inserted means that, on wide goods, one-eighth of a yard is deducted from the length of the piece, with a corresponding reduction in price. On narrow goods a quarter of a yard is allowed for each imperfection.

These small items add up to a costly total, and show how necessary it is that extreme care be used to the small points in finishing; more especially as applied to the burling and mending processes, because nine-tenths of the imperfections can be traced

back to neglect or inability, during these processes, to make good the weavers' shortcomings.

The inspector is also required to notify the finisher of any faulty work in his department, and when correction is possible to send the piece back to be refinished. There is a limit to the number of imperfections a piece may contain, and still sell for first quality, because the buyer objects to many imperfections in the cloth even at a reduced price; for the imperfections make economical cutting difficult. While the number of allowances permitted to a "first" varies, the usual number is six; cloth containing a greater number being sold as "seconds."

Value of Inspection. During inspection the goods must be handled as carefully as possible, for there is no further process to rectify the effects of carelessness here. The goods must also be carefully compared as to shades; if more than one shade is found to a style, it must be so marked and a piece cut off for future reference. A sample should be cut off every first piece of a style, to enable the inspector to compare it with all subsequent pieces of the same style. Where fancy goods are made, samples should also be given to the shearer, or at least samples of such as are considered satisfactory, in order that the same effect may be produced. The sides must be compared with the middle and with each other as to evenness of shade and the ends should also be compared. In doing this the evenness of the shearing should also be noted. If ordered to pass some work not up to quality the inspector should take note of the number and style of the piece so as to prove, in event of complaint, that he was not responsible.

MEASURING, ROLLING, AND PACKING.

Measuring. The goods having been inspected are ready for measuring. This is done either on one of various styles of machines built for the purpose, or in the following manner: A table, usually five yards long, is provided, upon which yards, halves and quarters are marked, and over this table the goods are drawn. The end of the cloth is drawn to the end of the table and a pin inserted, thus indicating the length of the table. The cloth is then drawn along until the pin is at the other end; continuing in this way until the piece is all measured, including that part left on the

table when the last pin is drawn to the table end. Then by counting the pins and adding the amount remaining on the table the total length of the piece is ascertained.

Before measuring, the heading, which is the unsheared part at the end of the piece, is cut off; also the similar part on the other end, leaving, however, the number attached for future reference. When an imperfection is found near the end, the cloth is usually cut off at that point to be sold as a remnant. The number of pieces is now recorded, together with the length and allowances, and a note of remnants cut, if any. A ticket is made out for each piece, on which is recorded the style, gross length, and length after deducting allowances. The ticket has also a place to indicate the number of the case into which the cloth is packed, but this number is not placed on until the invoice is taken. With a complete record such as this at hand, the finisher can calculate to a nicety how to regulate the shrinkage or other matters pertaining to the fulling, etc. The ticket is laid on the piece, to be fixed in its place after the cloth is rolled up. While the above is a rather primitive method of doing the work, many mills still use it where money could be saved by the use of machinery.

A machine for measuring, but not doubling or rolling, is illustrated at Fig. 69. Its operation is so simple as to require no explanation. The machine illustrated at Fig. 70 is more useful because it will also double the cloth, but the one represented at Fig. 71 is a still later style and has the added advantage of requiring less floor space. All of these machines are too simple to require detailed explanation.

The *measuring device* on the machine illustrated at Fig. 71 differs radically from the others; instead of a round dial, the indicator is mounted on a screw shaft which is geared into a carrier gear driven from the measuring drum. The fork which rests on top of the cloth is attached to the screw shaft, and when lifted into the position shown in the illustration the small gear of the screw shaft meshes with the gear on the other small shaft, causing the indicator to travel along the registering rod, thus showing the number of yards measured. As soon as the cloth runs off the drum the fork drops into a slot in the drum and through the connections throws the indicator shaft out of gear instantly, and, though the machine

continues to run, the indicator will not register. This is a very accurate method of measuring.

When the goods are measured and rolled up before packing, a letter or figure is usually punched out at the end, for the pur-

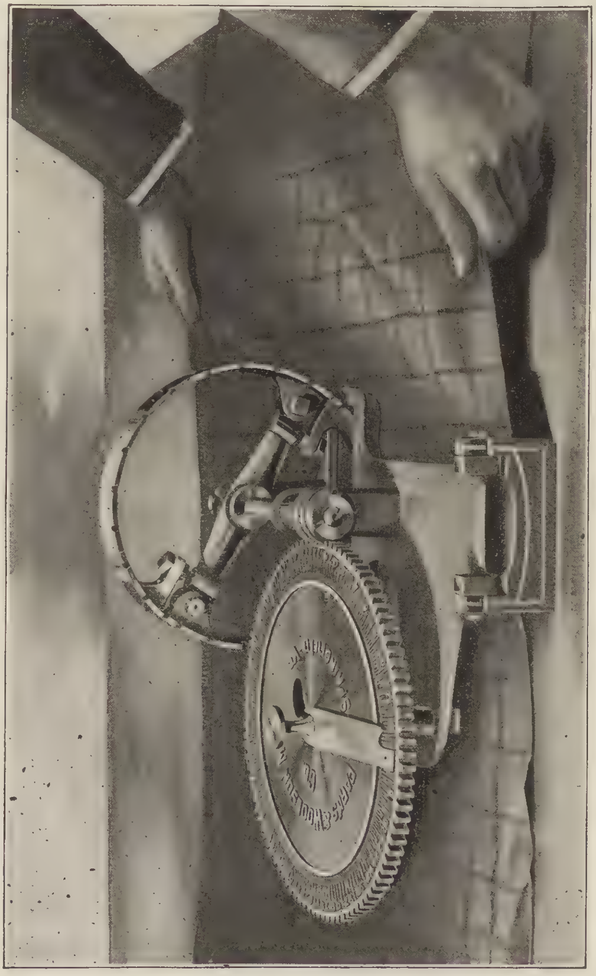


Fig. 69. Parks & Woolson's Standard Measurer.

pose of showing that no material is cut off after measuring. Occasional dishonesty among buyers, in making shortage claims, has led to this custom. In some mills silk is stitched across the end in addition to, or to take the place of punching. This done the

roll of cloth is bound with a piece of tape about four inches from each end. The tape should be tied on neatly and uniformly because, while of no real importance, it immediately suggests that

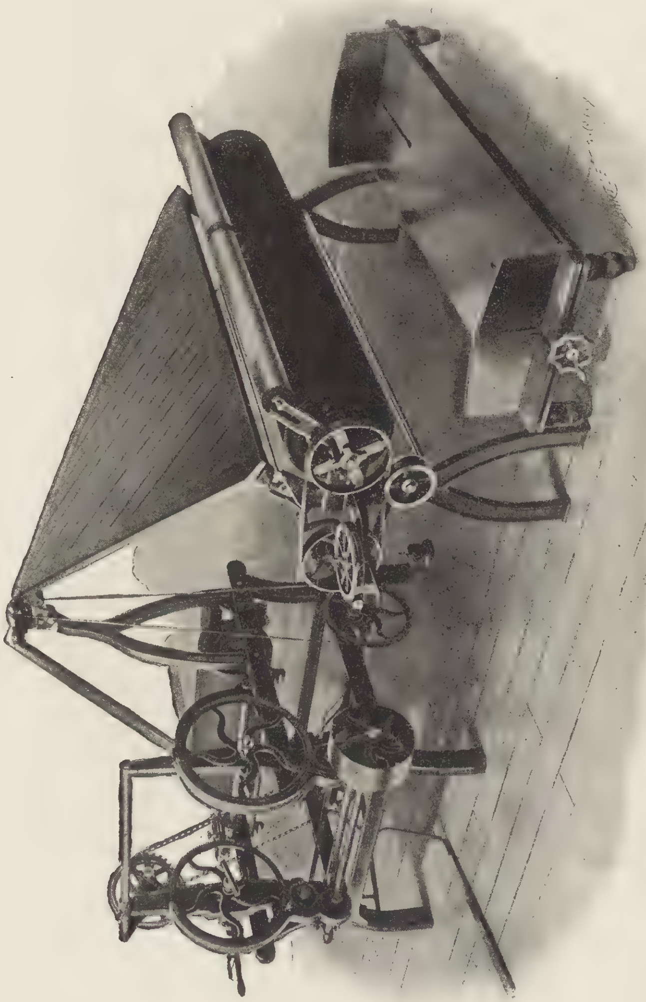


Fig. 70. Parks and Woolson's Doubling, Measuring and Rolling Machine.

care and neatness is the custom with the manufacturer. The ticket is now attached at the list end of the roll near the board on which the cloth is wound; taking care that the string passes through only

one thickness of cloth, otherwise the goods cannot be unwound and opened out.

After the goods are taped they are weighed, generally on a scale similar to steel-yards, the beam of which is graduated to pounds on one side, and ounces and tenths on the other side. The weight taken is for one yard only. In order to obtain this

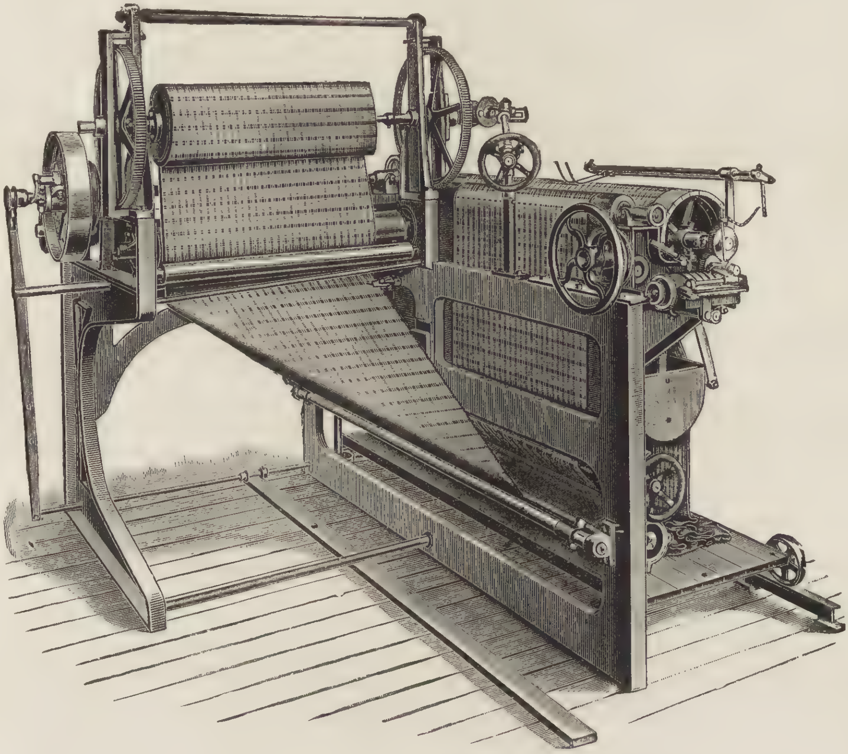
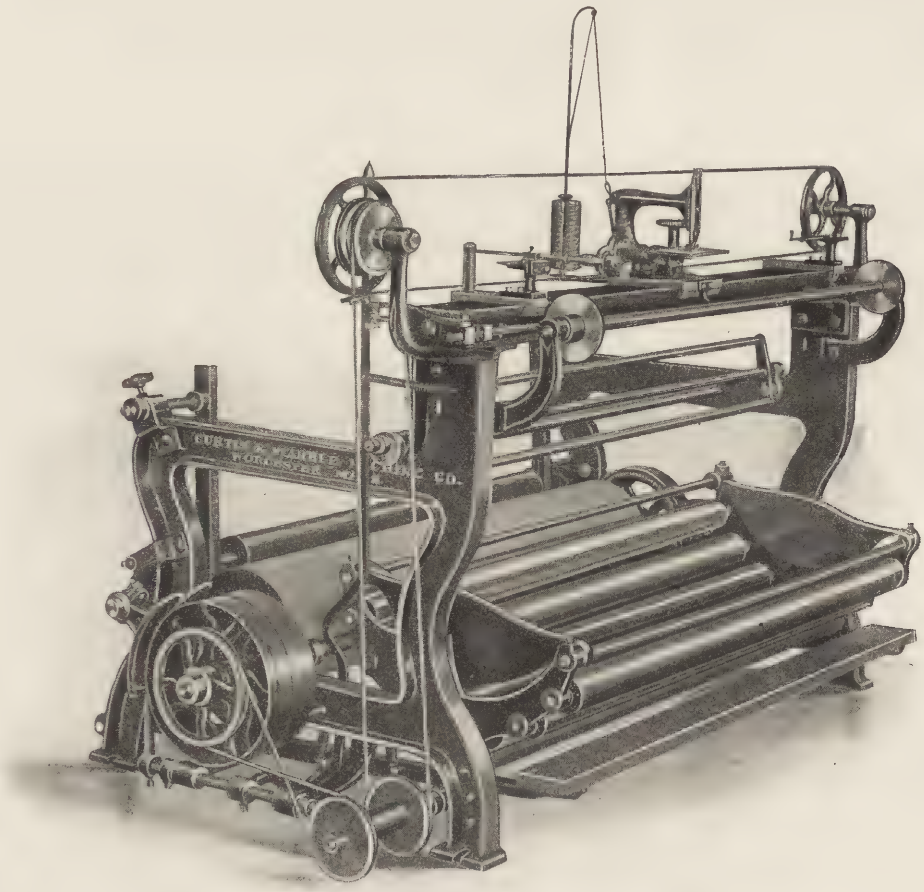


Fig. 71. Windle's Doubling, Winding and Measuring Machine.

result the weights put upon the weighing pinion are divided into yards so that there are weights for $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 3, 5, and 10 yards. Then the gross number of yards is put upon the pinion and balanced on the beam. For instance, if a piece is $38\frac{7}{8}$ yards long, three 10-yard weights are placed on the pinion, together with 5, 3, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$-yard weights, and when balanced on the beam, the exact weight per yard is shown in ounces and tenths, which weight is noted on the ticket.

Wrapping. All that remains to be done now is to roll up in paper and pack. Wrapping up is done by placing the roll on a sheet of paper of suitable size with the ticket at the right, then turning up the paper over the roll, the nearest end inside, and placing a weight on to hold it in place. Then a slit is cut in the right end of the paper through which the ticket is passed and the top, side, and bottom ends are folded in smoothly; repeating at the opposite end. The tie-up twine is measured off by laying three times from the table over the piece to the table, with an allowance of about a foot on the end, the length so measured being just sufficient. A knot is tied at the end of the cord, when it is passed around the roll about six inches from the left end, a slip knot then being tied and drawn up tight; this same operation being done at the other end, the cord is passed around the roll lengthwise and tied at the point of starting in such a manner that by pulling on the end, the knot is readily loosened. The pieces are then placed in a pile with the ticket end on top until sufficient are at hand to fill a case, when the invoice is taken; the number of the case being marked on each ticket, and the ticket slipped under the cord, face down. The case is then packed, the cover nailed on securely, and when properly marked it is ready for shipment.



IMPROVED RAILWAY SEWING AND ROLLING MACHINE

Curtis & Marble Machine Co.

WOOLEN AND WORSTED FINISHING.

PART III.

Parts I. and II. have dealt with the principles of finishing, their object being to explain the methods and machines generally used for finishing woolen and worsted cloths; but there are standard cloths which require special treatment at various stages of the finishing operation. This condition is due to the variety of stock used in the manufacture of the goods, and to the variety of effects demanded by the trade.

Two fabrics, on which radically different effects are required, may be treated in the same manner for part of the finishing process and then branch out into special lines; for instance, two fabrics may be given the same treatment in every operation except gigging and the results be so unlike that one would suppose they were produced by entirely different means.

To produce goods with the right "feel" or the correct appearance, it is necessary to know the soap and the temperature best adapted to the goods, the time required for each operation, and other seemingly small but really vital points.

The various classes of worsted goods require special treatment to bring out the clear, sharp effects peculiar to that class of goods. Union fabrics require still another method, and so on over the whole range of goods manufactured in woolen and worsted mills.

The following processes for finishing standard fabrics are the result of long experience and careful experiments, conducted with a view to determining the methods necessary for the production of the best finish on each fabric. Goods finished by these processes have stood the practical test of competition, which insures the practical nature of the following suggestions :

CASSIMERES—SAXONY FINISH.

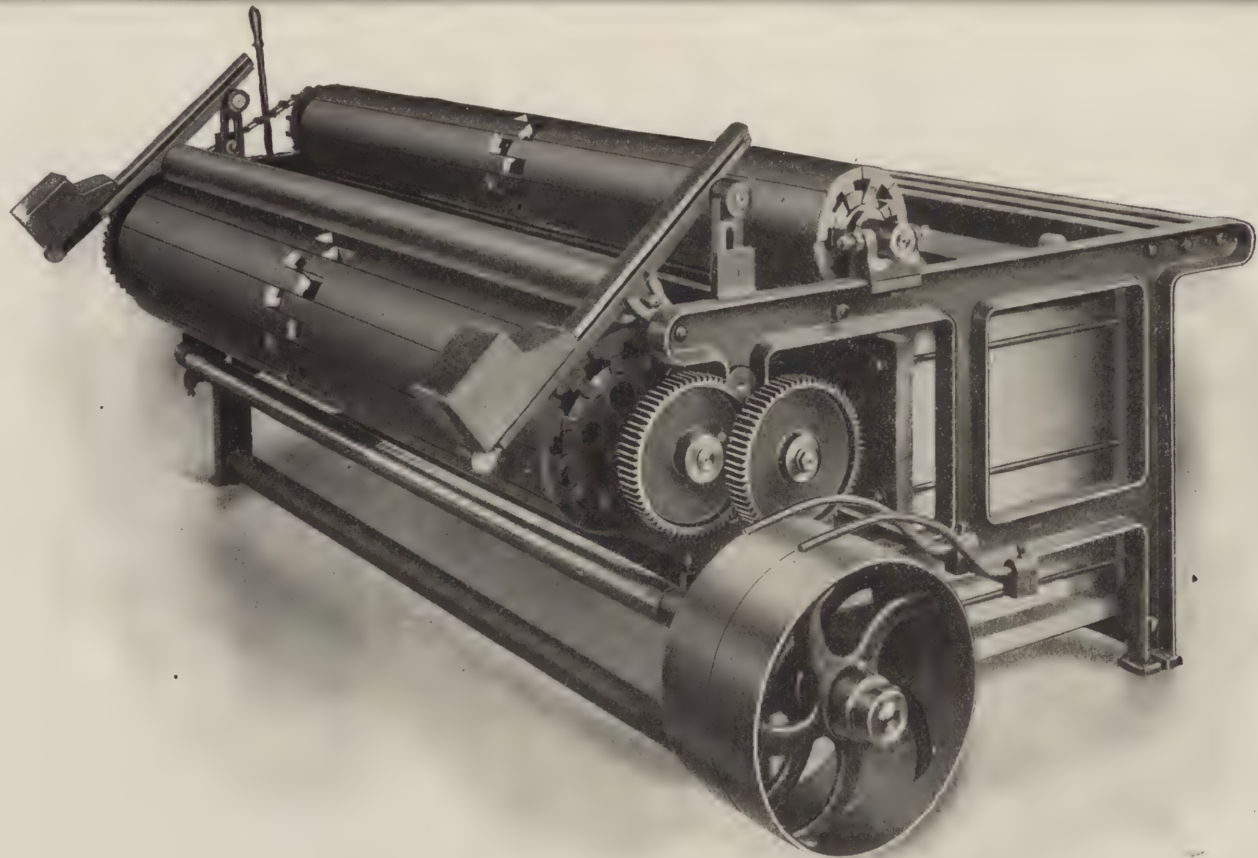
Cassimeres, as such, receive different kinds of finish. Perhaps the most important of these is the Saxony finish, therefore it will be explained first.

Fulling. In order to bring out the full beauty of this finish, the goods should be constructed with special regard to it. They should receive from four to five hours fulling, and should be shrunk in length at least four inches per yard, so that a firm and well-felted fabric will be produced. The details as to the preparatory process are substantially the same as on all cassimeres and close-finished goods. The fulling, while of importance should not differ from that of any other well-felted fabric, except to insure a good felt it is necessary to *limit the alkali* in the soap to the smallest proportion consistent with good work. Two ounces of pure alkali or four ounces of sal soda to the gallon is sufficient.

Washing. No departure from the usual method of washing is to be noted, and if the proper care is exercised during the rinsing operation, the goods will be freed from soap and the result satisfactory. After the washing a bath of fuller's earth should not be omitted, which on this finish will be found of especial benefit; but care must be taken not to have the solution too heavy. Fuller's earth at best is hard to remove from the goods, and if an excess is used in the solution, the goods will feel clammy and look pasty when finished.

Rolling and Stretching. After the goods are thoroughly cleansed of fuller's earth they should be put on the rolling and stretching machine, of which a desirable pattern is shown in the illustration at Fig. 72. This machine needs no explanation, as the figure shows plainly how it is operated. When used on these goods, it is a good plan to fill the tank with warm water and have the goods pass through this before going on the stretch roll, as by this means better results will be obtained.

After being tightly rolled up, the goods are left to drain over night by laying them flat on skids. In winding it is advisable to roll the goods as tightly as possible, for the tighter they are rolled the more evenly they will drain. If squeeze rolls are employed it is advisable not to squeeze the goods too dry, for they should not



BOILING, STRETCHING AND ROLLING MACHINE TO SMOOTH OUT CLOTH FOR NAPPERS AND GIGS
Parks & Woolson Machine Co.

go immediately to the gig, but in every case should be let lie over night. The rolling and stretching and subsequent lying over

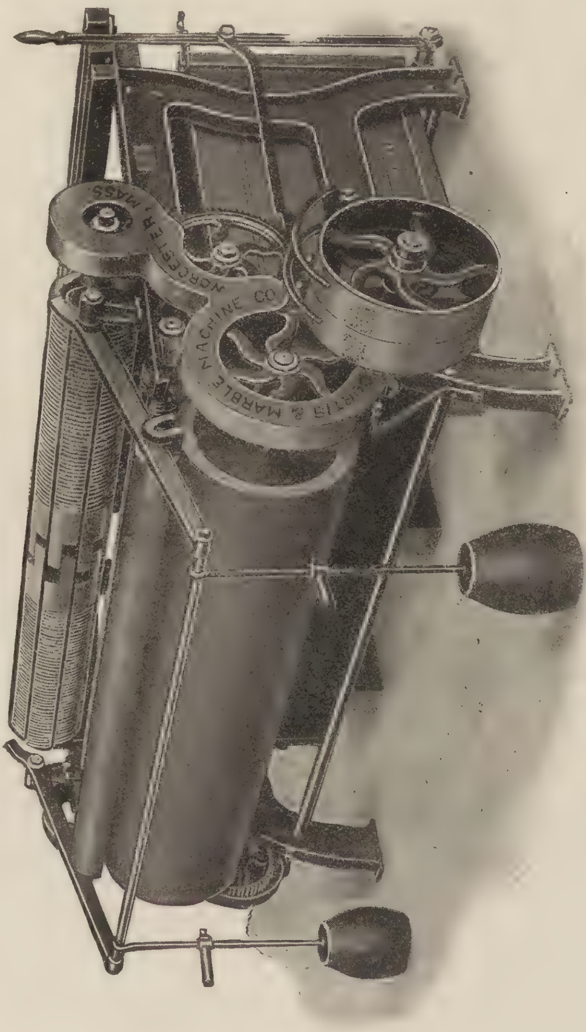


Fig. 72. Curtis & Marble's Rolling and Stretching Machine.

night is of the greatest benefit to these goods, as it gives them a smooth appearance when finished which cannot be obtained in any other way.

Gigging. The gigging process is where the finish is put on these goods, and if the fulling and other processes have been properly performed, the method here described will give the most satisfactory results. On a double cylinder gig the process is as follows: Both cylinders should be filled with old work and run in *opposite directions*, the goods being given six runs; then the flats should be cleaned and six more runs given. One flat should now be taken out to give a dry surface, then the next, and so on, till the whole cylinder is treated. For the back cylinder, the first flat is taken out and replaced with one grade sharper; then the next one is replaced by a grade sharper than the first, continuing in this manner until every flat has been changed. The goods should now be given six runs clean, flats turned, and six runs more given. At this point the old work which remains in the first cylinder should be replaced with sharp or new work, at the same time reversing all the flats. Now the old work in the back cylinder should be replaced by new work, and the front cylinder reversed so as to run in the same direction as the rear cylinder. When these preparations are completed the goods should be given six runs clear, flats turned, and six more runs given, after which they are taken off the machine. The goods are then sent to be speck-dyed.

After being speck-dyed, the goods are taken to the wet gig and given three or four runs with plenty of water. They are then folded off and taken to the extractor. After being *thoroughly extracted*, they are sent to the brush for a thorough brushing, and are then ready for the dryer. Every dryer ought to be supplied with a brush, but as it has not yet dawned upon the makers that this is a good and valuable addition to the dryer, one should be affixed by the finisher using it. After drying, a thorough dry beating should be given, and the goods are ready for the shear.

Shearing. The goods are sheared down slowly, plenty of runs being given so as to have them as even as possible. The beauty of the Saxony finish consists in having a little of the nap left on the goods so that there will be a soft feeling and still no spring to the nap. The threads should all show up plump and clear, and if these directions are followed the results will be all that can be desired.

A good steam brushing follows the shearing and this is in turn followed by an inspection. The goods are subjected to another steam brushing operation and then pressed. On the press they are run *face up*, tail end first, under a very heavy pressure. This will take much of the spring out of the nap and it will be hard to tell which way the nap runs. Four runs over the steam brush with a moderate amount of steam and the brush put on very lightly completes the finish. Inspecting, measuring, rolling, and packing follow as usual.

CASSIMERES—VELOUR FINISH.

As indicated by the name, the object of this finish is to imitate the velour or velvet effect. To do this, and also to make a perceptible difference between this finish and the ordinary cassimere effect, the nap is finished in an *erect position*. The proceedings at the different stages are much the same as in the previous finish until the cloth arrives at the gigging process. Here a departure from the former process is noted, for the goods should be run as moist as possible without dripping. This makes it necessary to give fewer runs at a time, for the teasels become wet faster.

Gigging. The gigging is started with old work, as on all classes of goods, and special care must be taken to prevent fibres from being pulled out. This is done by keeping the cloth from coming in contact with the teasels too much, which will also prevent the nap from being laid or flattened down. The aim is to have the nap as lofty and loose as possible.

Gigging in this instance differs much from gigging any other class of goods, sharper work being used because the cloth is not brought in such close contact. The work should be sharp enough to *pick up or lift* the fibres, instead of dragging them lengthways. After the gigging has proceeded to the stage where the sharpest work is employed, and when the bottom fibres need to be raised, the cloth should be put on closer to enable the teasels to reach the nap and get at the remaining fibres. However, great care must be taken not to injure the threads.

When the goods have been properly cleared and the gigging has been nearly completed, the last few runs are given reversed, but this should be very light, just simply enough to bring the nap

to an erect position, therefore the cloth is brought very lightly in contact with the teasels. However, it must be done evenly, so that no streaks or blotches will be perceptible, as will be the case if the nap is but imperfectly raised.

During the gigging operation the goods should be reversed frequently, if gigged on any but the double cylinder gigs, and on these both cylinders should be run in opposite directions until the last runs mentioned, when it is necessary to set the cloth off from the rear cylinder and use the front cylinder for turning only. Even then the work will in some cases be unsatisfactory. To overcome this difficulty on the double cylinder gig, it is a good plan to run the goods for this purpose tail end first throughout the process, and on the last few runs use the rear cylinder only.

When nappers are used, the goods are given two runs straight and one run reversed, leaving the goods without contact with the laying brush throughout the operation. The double-acting napper, which is illustrated in Part I., is the best machine to use for this finish, and if it is available, two runs in the usual way will accomplish the desired object.

After gigging speck-dyeing is in order, if needed, and that is followed by a bath of fuller's earth, which imparts a soft and agreeable feeling to the cloth. The goods are then ready for the dryer.

Drying. The only precaution to be observed here is that the dryer is not stopped during the process, for this will leave a streak wherever the face comes in contact with the rolls. At the dry beating, the goods should receive a couple of runs the usual way and then one run reversed; the last run should be very thorough.

Shearing. The cloth is then taken to the shear and the raising brush used *very lightly*, or it will have a tendency to turn the nap over. The nap is lofty and tends to an erect position by reason of the previous work the cloth has received. The back brush or laying brush should be put on in good shape, so that the nap may be properly laid on each run. The goods should not be sheared too closely, for with the treatment they have received, the nap is in such condition that the colors and pattern will show up in good shape even with quite a little left on the goods, while its erect position will give the goods the desired velvet feeling.

In pressing, the cloth is run the same as in the Saxony finish, tail end first with *face up*. When steam brushing, just enough steam must be used to take off the gloss of pressing, and not enough to affect the back of the goods, while the brush is used only moderately. In this way the goods will be smooth and it will be easy to feel which way the nap runs. By following this method the undesirable sharp feeling is avoided and a very pleasing feel imparted to the goods.

On *close-finished cassimeres* the goods may be handled in substantially the same manner, except that the shearing will have to be close, for the goods must be threadbare. On this class especially the gigging must be thorough, so that the goods may be sheared down closely and look clear, without having to resort to the scraping which would be necessary if not gigged properly, and which gives the cloth a harsh feeling.

UNION CASSIMERES.

This class of goods is generally composed of cotton with an admixture of a few woolen or shoddy threads for the warp; and a mixture of cotton, shoddy, and a little or no wool composes the filling. In common with all low-grade goods, it is a hard class to handle. The burling and mending need not be mentioned again, for these operations are necessary on all goods.

Fulling. Union cassimeres usually receive flocks to make weight, for shrinkage lengthways cannot be produced; in fact, to get them out right, it is often necessary to stretch them. The amount of flocks is usually of quite large proportions and therefore the goods should be tacked. After they are sewn together in the mill, one-half the flocks should be put on and the mill run for fifteen or twenty minutes before the soap is added. From two to four hours are required to full these goods, depending upon the quality of the stock. The soap used should be made with three ounces of palm oil soap or four ounces of cotton seed oil soap.

When the goods begin to get warm, the remainder of the flocks should be added. Five or ten minutes after the balance of the flocks have been added, the goods should be examined to see if there is sufficient moisture in the mill, if not, a little soap should be added. The *traps are not used* and all that is to be watched is

the width of the goods. As soon as they are up in width, an extra dipper of soap should be given, after which they are taken out of the fulling mill and put in the washer.

Washing. It is best to dispense with the use of warm water in the washer, for the colors are not of the best, and to have them look bright, it is just as well to use only cold water. However, the lathering should be watched and care taken that the goods are not taken out before they are well rinsed.

After the goods are thoroughly rinsed and before taking them from the washer, they are speck-dyed. After dyeing, another rinsing takes place, and then the water is shut off and the goods let drain, keeping them *in motion.* The gates should now be shut and each piece given two pailfuls of salt water, made by dissolving about twenty-five pounds of salt in a barrel of water. They should be run in this brine for five minutes and then taken out, leaving the brine in them. A thorough extraction comes next and then the goods are dried.

Gigging. They are now ready for the gig, and are treated here substantially the same as if they were moist. They should be gigged until they are clear, care being taken not to use too much sharp work. They will clear easily, for the felting capacity of the stock is of such a nature that there will not be much felt to break up. From the gig they are sent to the shear and sheared down threadbare. This should be done without scraping, if possible.

Specking follows the shearing, and is in turn followed by pressing. They should be run face up, being steamed lightly on the face and folded off behind. Examining, measuring, etc., follow.

CHEVIOTS.

In the last few years cheviots have been divided into two classes. Where formerly the rough-finished cheviot was the only fabric known by that name, there is now a close-finished cheviot. On the latter the threads show up plainly, somewhat like a cassimere, being in that respect the opposite of the rough-finished effect.

It is not necessary to burl these goods as thoroughly as cassimeres, yet they should receive a fair amount of attention. The mending depends largely upon the style; some styles showing imperfections more clearly than others. When bright colors are

used for the effect, the mending and burling must be carefully performed, that the patterns may *show up intact* in the finished cloth.

Fulling and Washing. It is not desirable to have much felt on these goods, for they are of an open nature, therefore, one to one and one-half hours fulling ought to be sufficient. With a fair-bodied soap, this will make the goods sufficiently firm and still leave them pliable enough for good handling. After fulling them to width and length, taking weight from loom and the finished weight wanted into account, they are taken to the washer and subjected to the usual treatment; then speck-dyed. A slight extraction follows, and then the goods are rolled up tightly and left till the next morning.

In some cases, especially the cheaper grades, the goods may be taken from the washer, thoroughly extracted, and dried at once. If they contain a percentage of cotton, and at the same time fancy threads, the latter plan is advised as the most profitable.

Shearing. After drying, the goods go at once to the shear, although this is often omitted. However, a run or two on the shear will benefit them, if nothing but the long hair is clipped off. On close-finished goods, the shearing has to be continued until the proper clearness is reached, but they should never be sheared threadbare.

Pressing. These goods are pressed *face up under heavy pressure*, using steam on the press. The steam brushing is omitted, for the goods get all the brushing that is necessary on the press. The usual final operations follow.

KERSEYS.

The finer grades of kerseys call for quite an elaborate finish, and quite an amount of work has to be put in on them to produce the required results. One great mistake is usually made, and that is the steaming of the lower grades. There is nothing gained by this, but on the contrary, the goods are actually harmed by the process, as it tends to show up imperfections, of whatever nature they may be, more plainly than the simpler water finish would. Having a good article, well constructed, it is well enough to bring out the inherent lustre of the fibre to the fullest extent possible and steam finishing is in such cases an imperative necessity.

Usually the construction of the lower class is of an imperfect nature, from the fact that all manner of expedients are resorted to to produce a piece of cloth as near as possible to the genuine article of higher price, but which is so only in outward looks. Nothing will bring out imperfection in construction more clearly than the steaming process. But with the water finish, while the lustre obtained is not as high and permanent, the faults may be successfully hidden from view. However, as the steam finish is the one usually employed, it will be explained first.

Burling and Mending. The burling of kerseys must be thor-

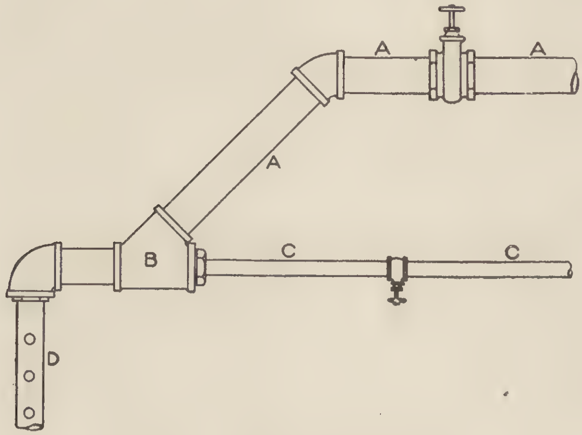


Fig. 73. Device for Heating Water.

ough, and anything which will tend to mar the smoothness of the fabric must be carefully removed. The beauty of the finish depends upon the smoothness of the fabric, and therefore all bunches and knots should be taken care of. As far as the mending is concerned, there is very little to be done on them except on some heavy weights, on the back of which it is necessary to sew in misspicks and replace missing threads. If this is not done, they are likely to make a dull mark on the face of this class of goods, while on others they do not show so plainly. These things will speak for themselves in the finishing, and can be regulated as one or the other way is found necessary.

Misspicks on the face may be cut by running a sharp knife under the threads which have not been bound down in the weaving,

and after the goods are fulled they will not be noticed. On *wool or yarn-dyed kerseys*, however, it often happens that to produce a certain effect the warp yarns are of one color while the filling yarn is of another. In such cases all misspicks will have to be sewn in on the face, for the cutting will not obliterate them.

Fulling. After the goods have been properly burled and mended they are tacked in the manner described in Part I., and are then ready for the fulling process. The first question which presents itself is whether it is best to full the goods in the grease or have them scoured first. As all the essential requirements for a good kersey may be obtained in from five to six hours fulling, the scouring of the goods before fulling is not necessary, and they may, therefore, be successfully fulled in the grease.

The soap should be of a good body; three ounces of palm oil and one ounce of tallow soap to the gallon will give sufficient body to last through fulling and be enough for the washing also. As alkali has a tendency to hasten the fulling, it should be reduced to the extent necessary to properly start the grease. About three ounces of pure alkali will do this or six ounces of sal soda.

As a usual thing more or less flocks are used on kerseys and even on the finest grades; flocks, if of the proper quality and moderate proportions, are found to be of benefit in that they help to fill up the crevices and thus produce a solid and smooth fabric. The flocks are best put on *after the goods begin to felt*, that is, after they have begun to get warm; and, to be more effective, should be put on in small quantities at a time. This will retard the fulling process, but that is rather more beneficial than otherwise.

Washing. When properly fulled the goods go to the washer and are thoroughly washed and rinsed. The rinsing must be very thorough, for the goods are intended to be steam finished and therefore must be clean, also because a small amount of tallow soap has been used, and can be removed only by a careful rinsing. Warm water is a necessity for these goods and should be used in the washer to the fullest extent. *In goods where tallow soap is used, warm water must be used to remove it.*

Figure 73 illustrates a simple method of heating water for the washer. A is the supply pipe, C is the steam pipe, B the point where the water and steam meet, and D is the discharge

pipe. The supply pipe should be at least $2\frac{1}{2}$ inches in diameter, and the discharge pipe not more than 2 inches, as by this means the heat may be regulated easier. A $\frac{3}{4}$-inch steam pipe will give sufficient steam for all purposes, too much steam making the water too hot, which is worse than cold water. The holes in the discharge pipe should be placed so the water will run on the goods as they pass down into the washer.

Having the goods properly cleaned, they are taken to the rolling and stretching machine and tightly rolled up. As much weight as possible is put on the rolls so that the goods may drain evenly and become as smooth as possible. They are left to drain over night and the next morning are unrolled and placed in even piles ready for the gig. The goods should all be unrolled at one time, not only as they are wanted at the gig as is done in some places. Each day's work should be placed by itself and taken to the gig in rotation. While it is of advantage to have goods lie in piles for some little time, they should be handled so that all will receive as near the same treatment as can be given them.

Gigging. It has now been satisfactorily established that nappers are just the thing for face goods, and therefore they are employed more and more, few places clinging to the old method of gigging face goods entirely with teasels; although there are many who still think it best to finish the gigging on the teasel gig. While it is not our purpose to discourage the use of teasels, it is a fact that the gigging process for even the finest goods can be satisfactorily performed on nappers. However, if goods are to be gigged on teasel gigs, the double cylinder gig will be found to be the best adapted for the purpose.

The gigging should be commenced with old work and the process conducted gradually, not introducing the sharp work until the very last. As the cylinders on the double gigs generally hold eighteen flats, it is best to divide them in three sets of six flats each, and make *six grades of work.* The first cylinder should be run reversed to within one grade of the sharp work, and on that as well as the last or sharp work, both cylinders should be run in the same direction.

Attention should be paid to the strength of the goods, both before commencing to gig and all through the process. This is of

the utmost necessity on steam-finished goods, as the steaming will make the goods tender if there is the least tendency in that direction.

Where the *napper is used* for part of the work, the goods should be run head end first on the first run, with moderate speed of the workers; then increasing the speed of the workers and giving another run, this time tail end first. The laying brush should be put on the goods as hard as possible, for on this finish it is an object to lay the nap. Then take the goods to the gig and finish them up, starting here with the cylinders both going in the same direction. Have the front cylinder filled with next to the sharpest work, and the rear cylinder half of medium, and the other half sharp work. The cloth is at first put in contact gradually, but after one run is put on closer and toward the end of the process is in as close contact as possible, so that the nap will be well laid.

Cropping. If it is required to crop the goods, which should be done on most fine goods, the pieces are taken to the shear when the gigging is about half done, and in some cases, as in this latter illustration, they are cropped after coming from the napper. When cropping, it is advisable not to go too low on the goods, for if this is done, they will look thin and open when finished. The object is to remove some of the nap so as to give the teasels a chance to do their work more thoroughly, and at the same time to even up the fibres already raised, so as to give the goods a smoother appearance.

To produce the most satisfactory results by this process, the raising brush should be taken out and a wire brush substituted, as the latter will raise the moist nap better. The raising of the nap for cropping must be thorough and even, so that all the fibres may be sheared to an *even length.* It is too often attempted to do the cropping in one run over the shear, but for all practical benefit this does, it might as well be omitted. Pieces cannot be cropped evenly in one nor in two runs, for the cropping should be conducted as carefully as any other shearing. The correct way is to go down on the goods by degrees, and when low enough to give them several runs to even the nap. The cloth is then taken back to the gig and the work completed in the manner above indicated.

When the *napper alone is used*, the goods should be given one run tail end first and one run head end first, then increasing the speed of the workers and giving another run tail end first, after which the goods are sent to be cropped. After cropping, the goods should be run on tail end first and again increasing the speed of the workers, one run should be given. The workers are now put on the fastest speed and the cloth given one more run, this finishing the goods in good shape. The laying brush of the napper and the cloth should be kept in the closest possible contact throughout the operation.

Sometimes it is advisable to crop the goods twice, and if this is thought best, divide the two cropping processes evenly with the napping work. This is done by running the goods through once with the head end first, then cropping; next giving two runs, the first run tail end first, and the second run head end first, then cropping again, and finishing as explained above.

There are three methods indicated here by which the work may be done, but these should not be taken as infallible guides, for more judgment is required in gigging than anywhere else; therefore the goods must be closely studied and a method adopted which will give the best results. Watching the work and seeing the results on pieces when finished is the only way to determine the best way to conduct the gigging.

Steaming. The next process the goods pass through is the steaming. When running the pieces on the steamer, it is well to bring them under the first cylinder from the loading drum, and then over the break and stretch rolls to the brush. The tank should be filled with water so that the goods will be well wetted before coming in contact with the brush; while the brush should be put on as hard as possible, so that the nap may be laid on as smooth as possible. When this is done, the goods may be steamed at once, it being unnecessary to use the cylinder to wet them. The steaming process should be continued long enough to give the required finish, observing all the points as given in Part I.

If one steaming does not give the required finish, a *second steaming* should be given, care being taken to find out if the goods are able to stand it. After each steaming the goods are thoroughly cooled, and they are then ready for carbonizing if this is thought

necessary. If piece dyes, they are ready for the dyehouse; or if wool or yarn dyes they are taken to the washer for speck-dyeing, and are then ready for the wet-gigging. A bath in fuller's earth should be given after speck-dyeing.

On the wet gig, the goods should be given about four runs up and down with plenty of water and then rolled up firmly and stood on end over night, after which they are unrolled and thoroughly extracted or squeezed. The squeeze rolls are best suited for this purpose and should be employed; however, if they are not at hand, the goods should be well straightened on the brush before being put on the dryer. After drying the usual process of *back burling* is employed, and this is followed by *steam brushing* and *shearing*. The goods should not be hurried in the brushing, but the operation should be as thorough as time will permit, for the action of the brush and the steam are of the greatest benefit, and will much enhance the value of the finish.

Care should be used in the shearing process which follows, plenty of runs being given to ensure having the nap as even as possible. Another brushing follows and then the goods are specked if necessary. They should now be inspected and if satisfactory, given one more steam brushing and pressed.

Pressing. As these goods are worked all the way through with a view of bringing out the inherent lustre of the wool fibre to the fullest extent, the work is continued on the press by running them *face down* or next to the bed. A slight steaming between the stretch roll and the cylinder just before they enter the press, will help them, although in most instances they will do very well without this. A moderate pressure is sufficient and is followed by another steaming on the face, after which they are rolled up on the press. They are now ready for the final inspection, after which they are measured, rolled, and packed.

Water Finish on Kerseys. This finish is substantially the same as the first described, except that the steaming process is omitted. Water finish being mostly used on low-grade goods, the gigging must be watched closely to preserve the strength of the goods. Speck-dyeing follows gigging and is in turn followed by wet-gigging. The other processes are the same as in the steam finish.

MELTONS.

The difference between meltons and kerseys is found in the gigging. While kerseys are practically "made" in the gig room, meltons do not enter this department at all, or at least should not, for the characteristic of a melton is opposite to that of a kersey. After fulling and washing, which processes are substantially the same as on kerseys, the goods go at once to the steamer. Carbonizing and dyeing follow, except on wool dyes. *Speck-dyeing must not be omitted*, and after this the goods are taken to the stretching and rolling machine and tightly rolled up. They are left on the rolls till the next morning and then go to the dryer. When dry they go to the shear and are here sheared in two or three runs.

The shearing is simply for the purpose of cutting off the long hairs, and should not be too low. A light steam brushing follows and the goods are ready for the press. It is best to steam these goods on the press, and to press them moderately. They should then be steamed and either rolled up or run off the press and folded on a stand at the back. The usual treatment follows.

BEAVERS.

Goods of this class almost invariably imply cotton warps and considerable cotton in the filling; although on some of the better grades the face warp is of wool or its substitutes and the backing warp cotton. For this reason the work of satisfactorily finishing these beavers is one of the most difficult problems for the finisher. The great trouble usually is that too much is expected of the finisher in the line of producing sufficient lustre, for where there is little lustre inherent in the fibre it will be found hard to produce a good lustre on the finished fabric.

Fulling. The fulling process is usually long and tedious, a great deal of trouble being caused by mill wrinkles, which must be overcome in the usual way. The soap must be strong and of good body. As these goods are piece dyed, they must be washed clean, and all trace of soap removed by the washer.

As it is out of the question to shrink the goods in length, the weight must be made by the addition of flocks. As there is only the filling to take and hold the flocks, it is imperative that two things be carefully considered. One is to see that they are *heavy enough* before coming to the finishing room, so as not to require

an excessive amount of flocks to bring them to weight; and the other, to use only flocks which possess the *felting quality in a high degree.*

It should be the aim to produce a piece of cloth, which, though flocked to quite an extent, is not decreased in value. This can only be done by using flocks which have sufficient felting quality left in them so that they will become a solid part of the fabric and not shake out as soon as the goods dry. A fabric is never the worse for flocking, if this point is borne in mind; in fact, there is very little doubt that if the flocking is performed judiciously and with the right kind of flocks, the goods are improved by it.

Gigging. After fulling and washing the goods are rolled up tightly and let drain till the next morning, when they are gigged. If care is exercised any of the nappers may be used to good advantage on these goods. The fibres should be saved as much as possible, and for that reason the goods are run only one way and the *nap well laid.* The machine should be run slowly to get a thick bottom nap. If time allows, the goods should be cropped, for this will materially aid the finish.

After gigging the pieces are sent to the steamer and are steamed for from seven to ten minutes for each cylinder, after which they go to the dyehouse. A thorough rinsing follows dyeing, and the cloth is put on the wet gig for a good wet-gigging; it is then rolled up and left till the following day to be dried.

Steam brushing follows drying, and is in turn followed by shearing. The nap should be *trimmed lightly at first* and the raising brush kept in slight contact. Plenty of runs should be given, going down on the goods very gradually, and shearing as low as possible without exposing the threads. After shearing, they should be steam brushed again, and then pressed face down with a good hard pressure ; also giving a thorough steaming on the press. The usual operations follow.

CHINCHILLAS.

Chinchillas are a radical departure from the cloths previously explained, requiring specially constructed yarn on the face, and additional finishing machinery. The cloth should be constructed in the loom with a view to facilitating the finishing process, which chiefly consists in the production of a *thick, heavy nap.* If the

yarn is not handled properly in the spinning room, or if the cloth is of poor construction, the finisher cannot turn out a well-finished piece of chinchilla. If the face yarns are what they should be, there will be little trouble about getting a good nap; and after that is obtained the rest is comparatively easy.

The whole process of finishing is conducted with the object of producing a soft yet solid and substantial piece of cloth, which will have a full and well-worked nap. If all the conditions are right, the pieces are not put in the fulling mill; for when fulling is

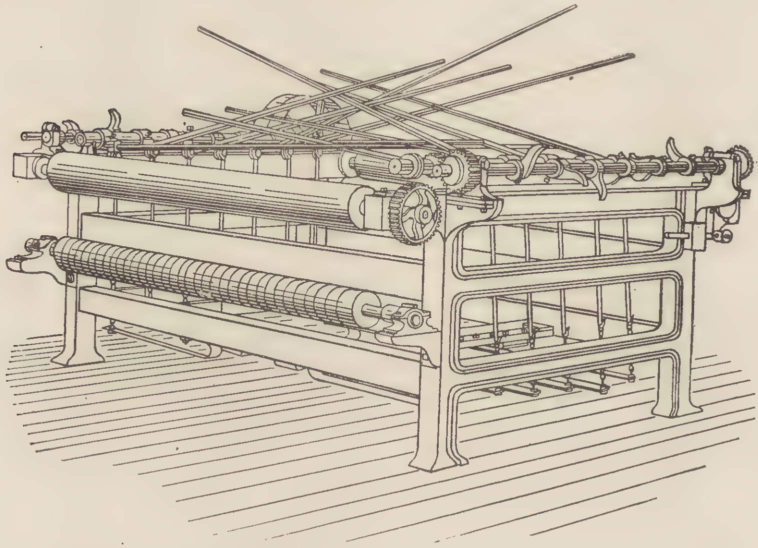
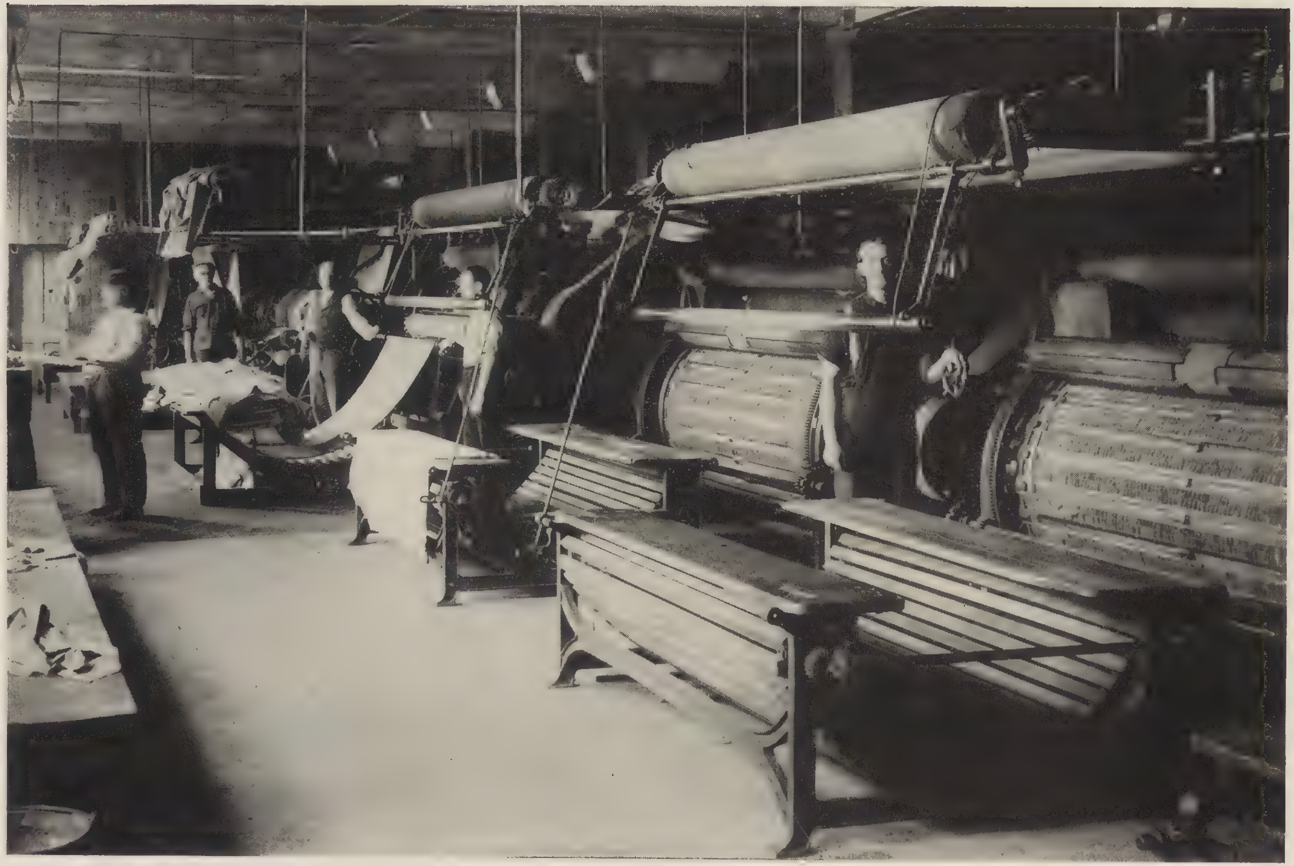


Fig. 74 Kinyon Bros. Whipping Machine.

necessary, the goods are not constructed properly and the finish will not be just right. The aim of the maker should be to construct cloth on which the necessary amount of felting will take place while the goods are being scoured, for if it is necessary to run them in the fulling mill they are apt to be too stiff and boardy.

Scouring and Washing. When scouring or washing chinchillas the width must be carefully watched and special attention paid to the nap. Of course, the strength of the soap must be sufficient to properly start the grease, but unlike a soap for fulling, it is not necessary to have the body very heavy, for the grease is not held in suspension any length of time. But it should be heavier



SECTION OF NAPPING OR GIGGING ROOM
Firth & Foster Co.

than the ordinary soaps used in the washer, and therefore a soap made with two ounces of good palm oil soap or three ounces of cocoanut oil soap and three ounces of alkali to the gallon will be found to answer the purpose. The heavier the soap the longer it will take to remove it, and on these goods, as on all others, the soap must be well rinsed out. If this soap is used and plenty of warm water used to rinse it out, the desired result will be obtained without difficulty. After coming from the washer the goods are extracted and are then ready for the gig.

Gigging. This is the most important operation of the whole process of finishing, for at this point it is required to produce a full, and heavy nap, worked up clean from the bottom in such a manner as to leave no streaks, and to completely *cover all threads.* This requires patience and strict attention to business, or the result will not be creditable. The chief point to be observed on the goods under consideration, is the use of very dull work and plenty of time. Sharp work of any kind should be carefully avoided, as it will inevitably cut the filling and produce streaks. That the work used may not do more execution than is wanted, it is a good plan to have more moisture in the goods when they are started than is usually the case, as this will avert much of the danger of cutting the filling. Another point of danger is where the nap is reversed. Unless this is done with the greatest of care, bad work is sure to result.

The old fashioned *up-and-down gig* is much to be preferred for this kind of work, as there are fewer chances of doing harm; however, the rotary gig may be used successfully. When the gigging operation is nearly completed, the goods are taken off and put on the shear for a cropping. This should not be omitted, as it will impart to the goods an evenness which can hardly be obtained without it.

Shearing. When shearing these goods, there is slight departure from the ordinary working of the machine; the raising brush must be of wire so that the fibres may be effectively raised, the laying brush is not used. Shears for the purpose of shearing chinchillas are not equipped with a brush on the main shaft. The shear should be kept in good condition, so that one run will be enough to trim the nap evenly, all that is required being to *square*

the nap, leaving it as long as required for the finish. The goods are then returned to the gig and the process completed.

Whipping Machine. The fact that the nap should be in its proper position before the goods are dried, has been mentioned in these papers, but on chinchillas this fact again comes to the notice of the finisher in a forcible manner. The nap has been obtained by the exercise of the utmost care, and it is desirable to bring it to the best possible position before drying. For this purpose, the pieces are run over a machine termed a "whipper," which is illustrated at Fig. 74. This machine consists of a framework attached to which are thirteen slender rods of tough wood. The rods are actuated by levers and cams as shown in the illustration. The cloth passes over the framework, face down, the rods beating on the back of the cloth as it passes, thus bringing the nap to an *erect position.* The machine is placed in such a manner that the goods pass from it immediately to the dryer.

Drying. The machine used for drying chinchillas is of different construction than the ordinary drying machine, as is shown in the illustration at Fig. 75. During the drying operation the cloth does not come in contact with anything but the pins on the chains. These chains are at the sides, and carry the cloth through the machine. Hot air is supplied at a point below the cloth, and travels toward the point where the cloth enters; the machine being enclosed to make the heat of more service.

After the goods are dried they are again sent to the shear, and at this shearing the size of the "nub" must be taken into account and the goods sheared accordingly. If the "nubs" are to be large the nap must be *left long*, or if a close, fine "nub" is desired the cloth must accordingly be *sheared closer.* Uniform work and even shearing are necessary to obtain good results, for ragged work will result in uneven "nubs." When the nap has been cut to an even and uniform length, the cloth is put on the chinchilla machine.

Chinchilla Machine. The illustration at Fig. 76 shows one of these machines, commonly called the "Whitney" machine. The framework of the machine supports a bedplate about three feet from the floor and rigidly fastened to the frame. This bedplate is covered with a good grade of Brussels carpet, which is

firmly glued to the plate. On each side of the bed is a roll covered with short card clothing, these rolls being the delivery and

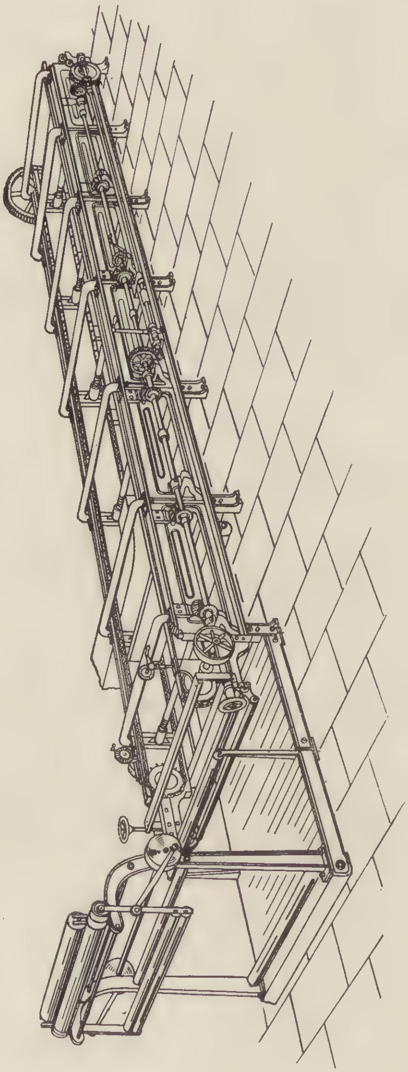


Fig. 75. Long Tentering and Drying Machine.

take-up rolls, by means of which the cloth is drawn over the bed-plate. Above this bed is found another plate of similar shape and proportions, but made of cast iron, whereas the bed is usually of

hard wood. This upper surface, which is called the follower, has a solid rubber plate cemented on the under side.

The follower is movable and can be raised or lowered by means of the handle and chain as shown in the cut. An upright shaft passes through each end of the follower, and is supplied with a mechanism to produce the different motions the follower is intended to describe, which may be rotary or reciprocating, backward or forward, from side to side, or diagonally, as is desired. The mechanism can also be set so as to increase or decrease the "sweep" of the different motions. Power is derived from main shaft of machine, and this is driven by a belt from power shaft in the room.

These machines are built to be used for *five distinct motions*, and the finish obtained by each is known by a separate name to distinguish from the rest. The most common names are the "Whitney" and the "Petersham," one being produced by the rotary motion, and the other by the reciprocating.

The *setting of the machine* requires considerable judgment and is one of the labors which are not amenable to fixed rules; correct judgment backed by experience, being the only thing that can be relied upon to adjust the motion correctly. It is not usually advisable to give the follower all the sweep the machine is able to give, the best results being obtained when the sweep is kept *below the limit of possibility.*

The proper care of the follower is very important, and the rubber plate on it must at all times be kept free from grease and dirt. If the follower is taken down about once a fortnight, and the rubber plate thoroughly rubbed down with some rough material, or cleaned with benzine, it will save much trouble and good work will be produced by the follower. It often happens that this is looked after as it should be, and still work will come uneven. In this case, attention should be directed to the woodwork to which the rubber plate is cemented, the rubber being removed and the woodwork placed perfectly true. The rubber is then put in place, and generally further trouble will not be experienced. The same precaution is also to be observed with the bedplate.

The *speed of the main shaft* of the machine should be from 145 to 150 revolutions per minute, which will give the follower

from 475 to 500 full motions per minute. It is therefore necessary to secure the mechanism in such a thorough manner that it cannot work loose and impart a different motion than the one with which it was started. This frequently happens if this matter is not properly attended to.

The piece is put on the bed and attached to the take-up roll and also to the delivery roll, then the follower is let down so as to

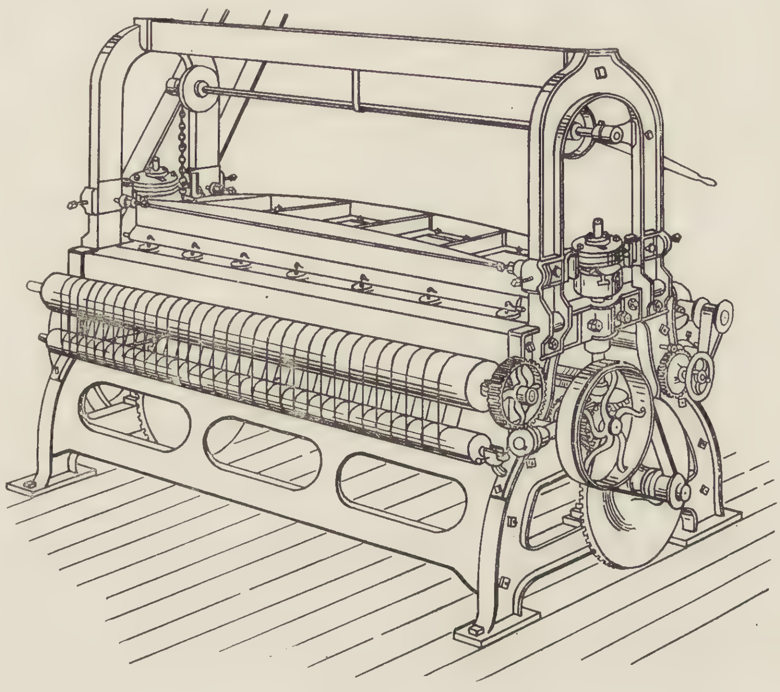


Fig. 76. Kinyon Bros. Chinchilla Machine.

touch the nap, and the machine started. The nub begins to form at once and the piece is run through to the end. On the common grades of chinchillas, one run through the machine is enough, and after the back has been carefully brushed the piece is finished; but on the finer grades it is necessary to return the piece to the shear, after the first run through the machine, and crop the nubs to the required size. When this is done, the raising brush is set off, for it must not be used after a nub has once been formed. Another run through the machine will give a fine and close nub.

After brushing the piece on the back, it is carefully inspected to see that the nubs are even, and then the goods are measured, rolled up and packed.

OUTING FLANNELS.

There is a demand for a large variety of these flannels. The 17-inch and 33-inch melton-finished goods find the most favor, because they are soft and clinging, and have a moderately high finish. It would require an expert to find a name for all the shades in which these goods are made, but the most delicate shades of rose, cream, and pink seem to predominate.

The yarns, of which these goods are made, have to be spun to very fine counts, and therefore the stock used is of good quality. In order to have a large and perfect production, it is necessary to size the warp yarns to aid the weaving, and this item often causes trouble in the finishing room. These flannels cannot be finished correctly unless the sizing is seriously considered, for such sizing as is generally used on worsted goods cannot be used successfully on them. The sizing should be of a nature to dissolve most readily, so as not to cause too much trouble in its removal. The burling must be thorough, while mending should not be needed.

Scouring. The scouring process follows the burling and is composed of a bath of warm water not exceeding 110° F., to which about 2 per cent of soda is added. For these goods, it is best to dissolve the soda previously and add the liquid solution. The pieces run in this liquor for half an hour, which is sufficient to properly loosen the sizing and remove most of it. The water is then drawn off and a strong but light-bodied soap is added with sufficient *warm water* to make a good bath. The soap used is preferably made with two ounces of palm oil soap and three and one-half to four ounces of alkali to the gallon. Four pailfuls of this soap are given to each piece.

The goods are run for thirty minutes and then the soap is drawn off, the sizing being well removed by this time; that is, if it is of the right kind. Another bath of soap and warm water is given, consisting of two pailfuls of soap and plenty of warm water. The pieces are allowed to run from twenty to twenty-five minutes in this and then the soap is drawn off and the goods are ready for rinsing. This process should be started with warm water and

after about twenty minutes the cold water is *gradually* let on, so that the change from the warm to the cold process may not be too sudden.

This is a point which is well worth remembering in connection with other goods besides these flannels, for much trouble may be averted at times by its observance. It stands to reason that a fabric which is being treated with warm water, cannot be benefited by coming suddenly in contact with cold water, and especially is this the case in winter. It is much better to have the whole process conducted with cold water, than to use warm water for part of the process and then suddenly change to cold water. Warm water, on the other hand, is of direct value, especially on flannels, and to obtain the best results sudden changes should be avoided.

The duration of the *rinsing operation* after the cold water is on cannot be definitely stated, for it depends largely upon the supply as well as the nature of the water, but it should be thorough. After the rinsing is completed the goods receive a bath of fuller's earth, which will effectually remove any trace of soap left in the goods. This completes the first scouring, and the pieces are extracted and sent to be dried.

Fulling. When dry, the goods are taken to the fulling mill, and here a good bodied but nearly neutral soap is used to give the foundation for the melton finish. The *traps are not used*, for it is not intended to shrink the cloth in length, but simply get it to width. The soap used at the mill is made of three ounces of No. 1 palm oil soap and two and one-half ounces of sal soda to the gallon.

The goods should be taken from the mill when they are within one and one-half inches of the width required; that is, for 27-inch goods, they should be taken out at 28½ inches, and for 33 inches, at 34½ inches. If taken out narrower than this, they will finish too narrow. They may, of course, be easily stretched to width, but this is at best a very poor policy, for this kind of fabric has a habit of creeping back. It is much better to finish the goods a quarter of an inch wide than too narrow. Besides, it is always best to *finish goods naturally*, and not resort to stretching more than is necessary to prevent wrinkles. There is nothing but

trouble caused by fulling the goods too narrow, and it can be easily avoided by close attention to the fuller.

Steaming. After fulling, the goods are again taken to the washer to be rinsed with warm water, followed by cold water and the bath of fuller's earth. They are now taken out and run open

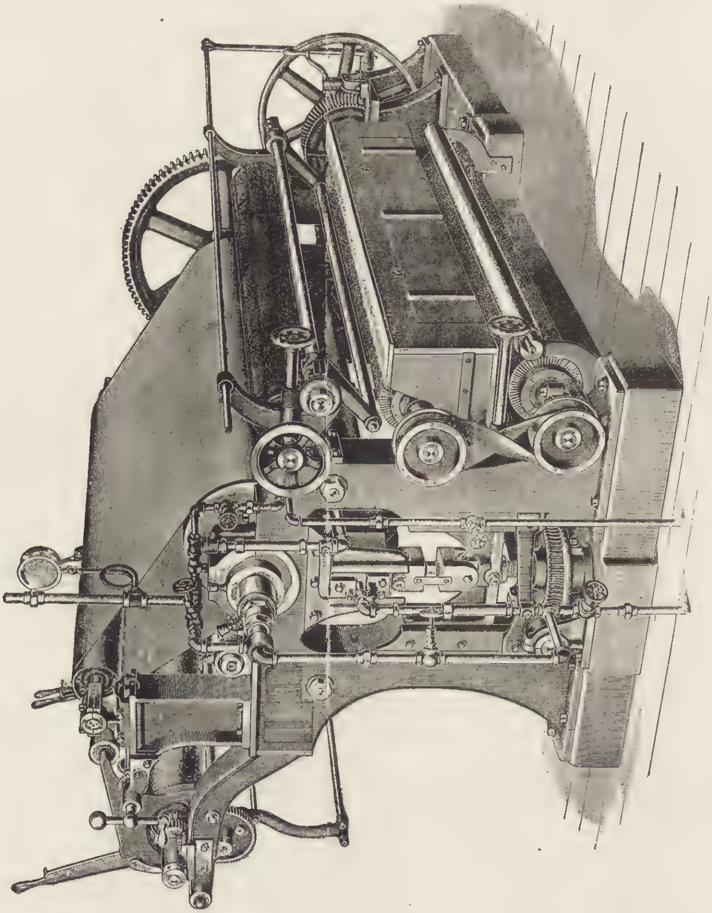


Fig. 77. Gessner's Apron Press.

through a pair of squeeze rolls, care being taken to *avoid wrinkles*, after which they are ready for steaming. The finish required is to be medium in point of lustre, and therefore the goods are only steamed, cooling with water being omitted. About four minutes steaming on each cylinder is amply sufficient, and they are then rolled on wooden rolls and stood on end for cooling, from ten

to twelve hours being required for this purpose. During this time the rolls must be frequently turned upside down, so that the moisture will not gather on one side and cause the goods to be of a different shade on the moist side, after being colored. Unless this is attended to, the cloth will be shady in spite of all the dyer can do.

After pulling the goods off the rolls they are inspected for spots and dark threads. This inspection is necessary on account of the delicate shades these goods are colored, and it is important that the lighter shades are only put on such pieces as are in every respect fitted for them, the pieces with spots and dark threads doing well enough for the darker shades.

After the goods are colored, they are again carefully rinsed and then dried. They should be dried about three-quarters of an inch wider than the finished width required.

The inspection follows the drying process and is in turn followed by shearing. These goods should be sheared quite low, and receive three or four runs to insure evenness, which cannot be produced on one or two runs. The pieces will look all the better for the few extra runs given, and therefore they should not be hurried.

Pressing. The cloth is now ready for the press, and still another style press is used, as is shown in the illustration at Fig. 77. This press is the opposite of the one shown at Fig. 80, for, as will be seen, the apron runs around the cylinder, covering it so the goods do not come in contact with it. While the press itself differs from others only in so far as the apron is concerned, it is in a class by itself, and is necessary on fine dress goods where it is an object to retain all the moisture possible, and have one side finished dull while the other side receives a high finish. The goods are run *face down with moderate pressure* and are steamed on the face either on the press or steam brush. This completes the finishing process, and the goods are ready to be inspected and wrapped up for the market.

FINE DOESKINS AND FACE GOODS.

The finishing of fine doeskins and face goods presents one of the best fields for a finisher to show his ability. Face finished goods of any kind require more time than is usually required in

the finishing of woolen goods, but on the finer grades such as doeskins, time should not be considered, but the sole aim of the finisher should be to excel in the finish. The difference in the time required to finish these goods does not play an important part in the total production, for after the finish is started everything comes along in rotation and the goods are taken care of very easily.

In the first place, the burling must be performed with the utmost care so as to have the fabric as smooth as possible. After the goods are properly burled, they are ready for the washer and are given a *thorough scouring.* The soap should be thin but strong, and the goods should be cleansed in good shape ; it being poor policy to slight the rinsing. They should then be thoroughly extracted and dried.

It is thought by some that the drying is not necessary, and that after thoroughly extracting the goods, they may go at once to the fulling mill. It is not worth while to argue this point, for it is self-evident that in such cases the moisture in the goods is not supplied by the soap, as it should be, and while a tolerably fair finish may be obtained, it will be found that the goods lack in one respect and that the most important, *i.e.*, the feeling of the goods.

In the theory of fulling as given in Part I., it is stated that the moisture should be supplied by a good-bodied soap. This is necessary for two reasons ; firstly, because the soap has a softening effect on the fibres, and secondly, because too much moisture has a tendency to make the goods feel hazy. It necessarily follows that if the moisture is received in the washer, it cannot be supplied by the soap; therefore, the *goods should be dried before entering the fulling mill.*

This is a good opportunity for the finisher to find out what per cent the goods loose on account of grease and dirt being removed, and he will thus be able to conduct the after-processes more intelligently. The goods should be weighed before entering the washer, and again when dried and ready for the mill. Only the gross weight in pounds is taken, and the loss can then be easily found.

Fulling. The goods must be run a long time in the fulling mill to give the fine and close felt necessary for the finish. A heavy bodied but neutral soap must be used, and this is preferably

made as follows: Four ounces of the best palm oil soap and two ounces pure tallow soap are used to the gallon; or, if it can be obtained, four and one-half to five ounces of olive oil soap. If this latter soap is used, the finish will be much better. The soap should be as near *neutral as possible*, but in order to produce a good homogeneous soft soap, it will be found necessary to use about one per cent of sal soda. With such a soap there is no trouble about getting the goods out feeling as soft as it is desired to have them.

The goods will run from eight to ten hours in the mill, and care must be taken not to let them get too dry, for after they become warm the moisture will evaporate; therefore, more soap must be added at times. Running so long the goods sometimes tend to roll, and if this happens the piece should be taken out, well-shaken, and run back into the mill, the other end first. This will usually stop the rolling. On all goods that run long in the mill, it will be found of benefit to shake them out once or twice during the process, as this will prevent mill wrinkles.

After the fulling is completed, the goods are again sent to the washer and are thoroughly washed and rinsed with as much warm water as possible, and when clean and free from soap they are given a generous bath of fuller's earth. After this they are taken to the rolling and stretching machine and given the same treatment as kerseys. They should remain on the rolls over night and then be folded off without wrinkles, and left in a pile twenty-four hours, after which they are gigged. The object of laying the goods in piles is to give them a substantial feeling. One experienced in the finish can tell by a mere handling whether the goods have lain that way.

Gigging. The use of the napper on these goods has been excluded about as long as possible but now it may be said that the old teasel gig is gradually being supplanted. One item of inestimable benefit is found in the use of nappers, and that is the absolute certainty of the same kind of work on all the pieces. That the grading of the teasels is a particular piece of work has never been denied, but even with the best of care there is no certainty that the work given pieces to-day will be the same as that to be given to-morrow. All that can be done is to make the work as

uniform as possible. Therefore, it is best to use the napper, and especially the double-acting napper if it can be obtained. There is no use trying to put off the use of the latest improved machinery; it is much better to try it, and study it, and in most cases, its use will be found to give the desired results. As on kerseys, so here, the aim is a *full, and dense nap*, and several thorough croppings should be given the goods and the laying brush used to the maximum.

Steaming. The goods are now ready for the steaming, and here may be noted a slight departure from the ordinary way. After the goods are run off one cylinder, they are at once run on the other. Both tanks are filled with water and the brush put on *as hard as possible.* The cloth is now run from one cylinder to the other, three or four times, or until the nap has been well brushed down so that the face is smooth. This must not be overlooked, if it is desired to have a good finish.

These goods are all wool and therefore no bad after-effects will be produced by a thorough steaming. A steaming is understood to be a steaming once on each cylinder; so that for a double steaming, the cloth should be steamed twice on the same cylinder, to save the time of running it back and forth. But this very running is of great benefit, as it brings the goods in contact with the brush.

After steaming the usual carbonizing etc., is in order. As there is no further departure from the method employed on kerseys, the other processes need not be mentioned again. These goods are all wool, and may be either wool or piece-dyed.

DOUBLE CLOTHS AND REVERSIBLES.

In some senses, double cloths require double the amount of care which is given to ordinary fabrics, the finishing presenting many phases that are not met with in single cloths.

The proper construction of the fabric is of more importance in a double cloth than in any other style, for no amount of care in the finishing can overcome a faulty construction. The cloth of which ladies' capes are made is a good illustration of this, for it is usually of a soft nature, with a plain black or dark blue face, and a large plaid of striking colors on the back. If the construction of these goods is faulty, and the binding of the white or colored

threads of the back pattern *protrude on the face*, it is next to impossible to bring the goods out clean looking; for the white or colored fibres will find their way to the face by the action of the gigging, and thus spoil the appearance of the fabric. But given a perfect fabric in this respect, a moderate amount of care employed at the right point will bring it out all right.

Burling and Mending. Right at the beginning of the finishing process, changes are made in the handling, and this is kept up all the way through. The burling should be performed with much more care than on single cloths on account of both sides of the cloth receiving a finish; and for this same reason both sides should be treated alike, and both regarded as the face. Where on other cloths, runners appearing on the back are not of much importance so long as the face is intact, on these goods they must be looked after the same as on the face. Both sides of the cloth should receive the same treatment in mending, for the pattern is generally in the combination of colors rather than in the weave, and all fancy threads must be in their proper places or they will show up imperfectly.

Fulling. The calculations preceding the fulling process must be made on a basis of per cent of loss sufficiently large to cover the extra loss sustained on account of the extra amount of work the goods receive on the back. Nor will it do to lose sight of this part of the work, for if proper provision is not made, the result will surely be a disappointment. Flocks are not often used, still on some of the cheaper grades, where more subdued colors are used, they are often a necessity, and when this is the case it is well to bear in mind that the usual allowance of flocks is not enough.

The common practice is to put on *two ounces of flocks for every ounce in weight* to be made up by them, for that is about the proportion which becomes part of the fabric when finished; but on ordinary goods the flocks which adhere to the fibres on the back are not disturbed by after processes. On the goods under consideration, however, this is changed, for the back of the goods receive a finish and consequently a portion of the flocks is removed. This must be taken into consideration when the flocks are added in the mill. Three ounces of flocks for one ounce in weight to be made up will be found none too many, and if the flocks are not of

the best quality, it is sometimes necessary to use *four ounces*. If flocks are not used, it is unnecessary to tack the cloth before fulling.

Some double cloths are not fulled, for instance, the cloth used for capes is simply scoured. On reversibles, however, it is necessary to full the pieces and to shrink them to width and length. The fulling process as well as the soap used, does not differ from the process used on other goods and is subject to the same conditions. If any tendency towards rolling or roping manifests itself, the goods should be tacked, and if that does not overcome the difficulty, the other method formerly advised should be used.

The *washing* does not differ from other goods, and the fuller's earth bath should not be omitted, for it will tend to brighten the colors. The treatment at the points thus far mentioned is practically the same as on other cassimeres, but commencing with the gigging process extra care must be taken.

Gigging. As stated before, if the construction is faulty, the colored fibres of one side will interfere with the effect of the other, but even if this is all right, injudicious gigging may produce the same trouble. The best method to follow at this point is to start the operation with old work and run the machine slowly, advancing to the sharp work. When running the sharp work, care is taken that it does not strike the goods too hard or the workers may go too deep and take hold of the fibres of the other side.

The back of the cloth is gigged first to reduce the possibilities of causing defective finish on the face. It must also be remembered that the chances of tendering the goods are double those on a single cloth; therefore, the gigging should be kept well within the strength of the fabric.

When the goods are properly gigged on both sides, the question of *speck-dyeing* arises, and if it is necessary, the proper time to do it is immediately after gigging. Of late years, the carbonizing process both for stock and pieces has done away with much of the speck-dyeing; still there are many places where the carbonizing process is not used, and on low-grade goods it is of course out of the question. After burr-dyeing and thoroughly rinsing the pieces are extracted and then dried.

Before taking the goods to the dryer, it is a good plan to brush them on both sides. The machine illustrated at Fig. 78 is admir-

ably adapted for this purpose. These machines, having four cylinders, which may be clothed with brushes instead of the sand lays, are used so that two of the cylinders will brush the face, and two the back, thus doing in one operation what would otherwise require two separate operations and handlings.

After drying the cloth is carefully looked over on both sides, the object being to remove knots; and this is followed by a steam brushing *on both sides.* The goods are then ready for the shear.

As a general thing, some of the nap is left on the back, even if the face is to be finished threadbare, but sometimes the back has to be sheared the same as the face. The shearing process is the same as on other goods, except that the *back is sheared first.* After the shearing comes the specking and that is in turn followed by another brushing, after which the goods are pressed. They are pressed with the face up and the steam brushing applied to both sides to remove the press glaze. The usual final processes follow.

LOW-GRADE GOODS.

Of all goods to be finished, the low-grade goods will always be found the hardest to bring out satisfactorily. More care has to be exercised at all stages, and many of the processes will be extended in time beyond what is usually the case with the better grades. To this must be added the desire on the part of the management to keep the labor cost down to the lowest point.

The finisher should insist on being given enough time to do the work right, for anything short of that will only hurt his own reputation; and while it is hard work to build up a reputation, it takes only one or two failures to lose it. It is a good plan to keep a close watch on the *soap*, the *fulling*, and above all on the *washing;* for nothing is worse than dirty goods, unless it is goods that are tender. The gigging should be kept well within the strength of the goods, for a poor finish is much to be preferred to a good finish with a tender piece.

THIBETS.

One kind of low-grade goods, which at all times finds a ready market, is the Thibet cloth, which on account of being made entirely of low stock may be taken as an example at this time. The genuine Thibet cloth, of which most styles in the market are imitations, has a firm, rough face, is soft to handle, has no nap, and

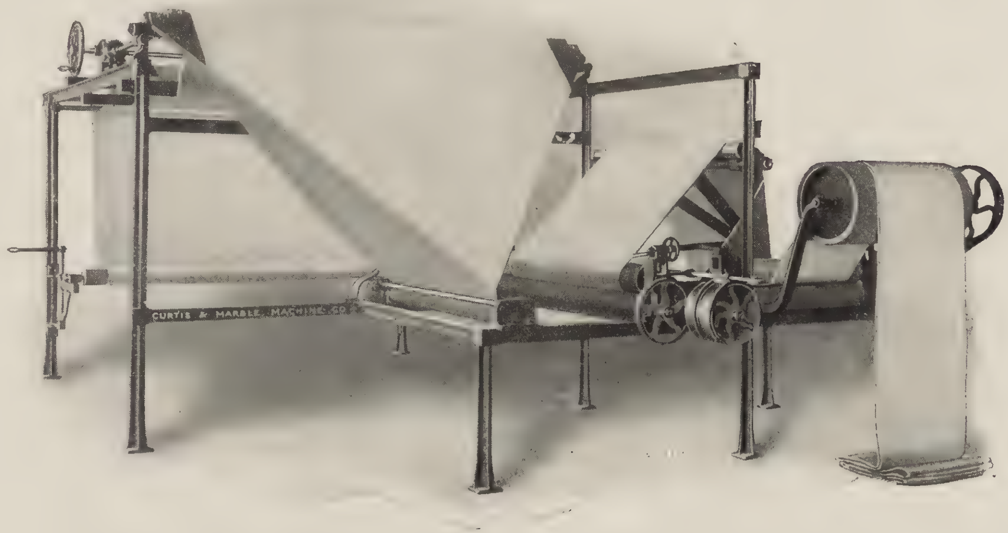
is either in fancy colors or dyed in the piece. A style of cloth is found on the market under the name of "blind cheviot," which is in reality a Thibet.

As regards the finish proper, it may be said that there is no distinct finish, it being somewhat of a mixture between a melton and a cheviot, neither of which requires much work in the finishing department. But even so, it will be found hard to produce the results that present themselves as a matter of course on better stock.

The first process, the burling, is usually a very laborious piece of work, for the grade of stock, as already indicated, causes many bunches and other imperfections seldom found in goods of better stock. Mending is usually omitted, the burlers pulling out double and coarse threads. The pieces are then *tacked*. This should not be omitted under any consideration, for as the stock is low, the face needs all the protection possible, so as to retain the fibres to cover the threads. If the pieces are not tacked, the fibres will wear off very much during the fulling process. It is of no consequence which method of tacking is employed if the work is done thoroughly.

Fulling. On account of the felting quality of a large part of the stock being very low, the pieces are run into the mill either double or treble, so as to bring as much cloth as possible under the roll. This also causes the cloth to go around much faster, thereby subjecting it to more frequent pressure, which aids the fulling greatly. But care must be taken that the fulling accomplishes the desired purpose, which in this case is not only the shrinking of the goods in length and width, but also to have the *weave well covered with felt.* This need not be hard and close felt but just enough fibres to cover the threads; for an excess of felt is apt to make the goods feel stiff, whereas a soft feeling is desired.

If the stock is of a nature that the goods shrink too quickly, or before the face is covered with felt, it is better to run them singly, even if they have to be doubled at the end to shrink them to width. In such cases it is a good plan to run the goods singly in the mill and have sufficient pressure on the traps to shrink them gradually in length. When they are about up in length the felt will cover the threads. As this is the result that is desired, the cloth should be doubled, as explained under the head of fulling,



DOUBLE-DOUBLING MACHINE FOR FOLDING CLOTH 4-PLY
Curtis & Marble Machine Co.

and quickly brought up in width, no pressure being used on the trap.

By this it will be seen that although the goods are cheap, they are quite a study for the finisher, and experience on low-grade goods is required to bring them out right. It is easy enough to finish goods made out of good straight stock, but to make a presentable article out of stock which in many mills is allowed to go to the refuse heap, is quite another matter. In the fulling mill the pieces must be run a trifle *more moist* than ordinary, for if allowed to run with the minimum of moisture they will chafe too much, and some of the stock that should be on the face, to cover the threads, will be found at the bottom of the mill, even though the goods are tacked in good shape.

Soap. A good soap for these goods may be made as follows: One and one-half ounces palm oil, one and one-half ounces tallow chip soap, and three ounces of pure ammoniated alkali, or crystal carbonate of soda to the gallon, made in the usual manner. This soap will stand fulling to the extent of from five to six hours and then be good enough for the washing operation. The only drawback to this soap is that it is hard to wash out of the goods, which is due to the tallow chip soap. Therefore the washing, which immediately follows the fulling, should be very thorough, and the rinsing should not be neglected.

On goods of this class, that is, low-grade, special care must be taken to have the goods *opened out and folded* as soon as they come from the mill. This is done by removing the tacking strings and opening the goods out, then drawing them over a perch and folding them as straight as possible, taking special care to prevent wrinkles. This precaution is necessary when the goods do not enter the washer immediately, and is done to prevent the wrinkles from showing when the goods are finished. If the goods are left for a few hours in the condition they come from the mill, all the wrinkles and creases will show up. It is almost impossible to remove wrinkles formed in this way, so it is best to avoid them as much as possible.

After the pieces are thoroughly washed they are speck-dyed, if they are wool-dyed goods, while if they are to be piece-dyed, they are now sent to the dyehouse. If wool-dyed they receive a

thorough speck-dyeing and rinsing, which is followed by extracting and drying. After being dried they are sheared, three or four runs being given to square the nap properly. Care must be taken not to shear them low enough to expose the threads. The raising brush is used very lightly, and the laying brush should not be on very hard.

A light steam brushing is next in order, and then the goods are ready for the press, where they are run with the *face next to the bed.* A moderate pressure is used and the face is thoroughly steamed on the press or steam brush. The usual after processes follow.

SATINETS.

Satinets are as low-grade as any goods manufactured, and are always piece-dyed and printed. They enter the finishing room about thirty inches wide and are finished twenty-seven inches. The lowest of low stock is used in them, the stockhouse of a satinet mill containing hardly anything but rags, which are converted into shoddy and then spun into yarn.

Fulling. The burling is only superficial, and is followed by the fulling process. As a general rule, satinets are stuffed about as full of flocks as it is possible to get them; therefore, one-half of the flocks are given dry and the other half wet. It is quite a bit of study to get the required amount of flocks on the goods, and careful study of all the conditions is required to get them out in such a manner that they fulfil requirements. The fulling mills for such goods as these are generally *without traps*, for the goods are not shrunk in length, being brought to width only, the main object being to get all the flocks on the cloth.

It is often the practice to gig these goods before they enter the fulling mill, and in most cases this is found beneficial, if not overdone. As the nap thus raised must come directly from the threads, there is always danger of tendering them, for it must be remembered that there is practically nothing to hold the fibres together, and every fibre raised from a thread will leave that thread so much weaker. If the goods are gigged previous to the fulling, the flocks will take much better and the face will be covered closer, which is the chief aim of the finish. Satinets are supposed to re-

semble face-finished goods, and if the stock is fair, quite a respectable looking finish may be obtained.

Soap. After the goods are in the mill and the first half of the flocks evenly distributed, the pieces are ready for soaping. In satinet mills red oil is used for making soap. When this is the case the soap should be made as follows: Four gallons of red oil are put into a barrel with sufficient water to fill the barrel one-third full. Sixty pounds of soda ash or alkali are added and the

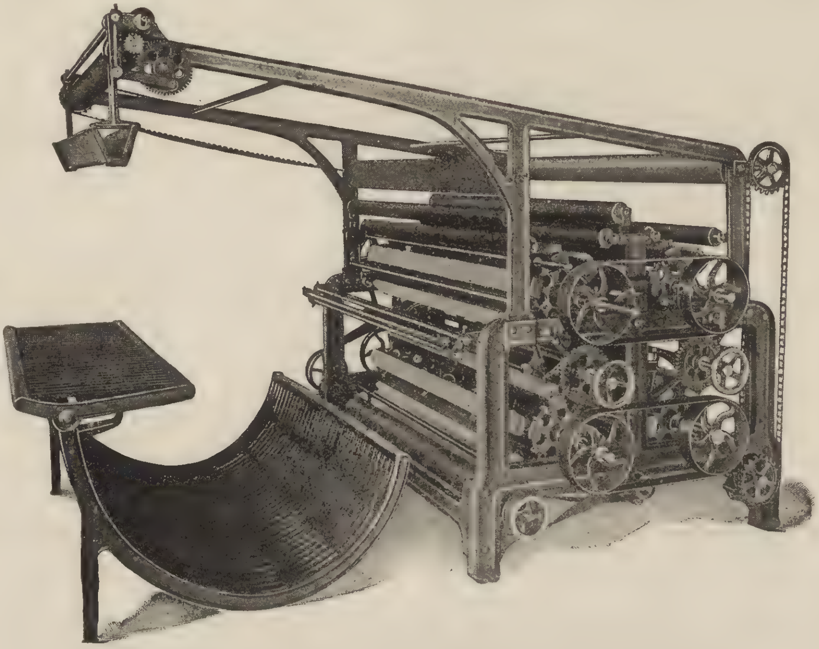


Fig. 78. Parks and Woolson's Sanding, Pumicing or Polishing Machine.

compound boiled for from six to eight hours. The barrel is then filled with water and the contents let cool.

On satinets it is not of so much importance to have the soap cold, as on other classes of goods; in fact, it is an advantage to keep it warm, for it will stay combined better. This soap will thoroughly loosen all grease in the goods and be strong enough to aid the felting. *Four or six pieces are put in the mill* at one time, which would make two or three on each side.

After fulling, the pieces are put in the washer and are thoroughly washed. Very often it is thought advisable to burr-dye

them in the mill and if this is required, a burr dye of at least 24% strength should be made, and one quart used for each piece. This will usually be sufficient to cover all specks. Burr-dyeing in the fulling mill is mostly resorted to when the goods are piece-dyed in a primitive way, for if union dyes are used it is not necessary to use speck dye.

Gigging. After washing, the goods are ready to be gigged. The gigging must be performed very slowly and carefully, and very little sharp work should be used. The goods will not stand much work in this respect, and therefore they cannot be handled as an all-wool piece or even as a mixed piece, which contains tolerably fair stock. The gigging should be done with a view to saving all the fibres possible and the production of a *smooth and well-covered face*. It is not necessary nor advisable to gig down to the bottom. The top fibres should be laid as straight as possible without disturbing the bottom fibres excessively.

The coloring follows next, black and blue being commonly used. The cloth is then dried, sheared, and pressed.

BLANKETS.

The finishing of blankets is chiefly done in the gigging, and unless the goods are made properly before they reach the finishing room, it is impossible to finish them correctly.

All the yarns should be made of stock which will felt easily, and which is of long enough staple to give the desired length of nap. They should be loosely twisted so as to facilitate the work of raising the nap, and also to make it unnecessary to put the goods in the mill.

The goods should be thoroughly scoured with a good-bodied soap to help the softness of the goods and care should be taken to have them clean and well rinsed before sending them to the gig or napper. The object here is to obtain a *dense* and *long nap* which must also be well laid and still retain a certain loftiness. Almost any of the machines in use which are wide enough may be employed on these goods, but as they run from nine to twelve quarter,* it will be easily seen that extra wide machines are required. Most

*NOTE.—A quarter means nine inches; thus nine-quarter goods would be 80 inches wide; twelve-quarter goods, 108 inches wide, etc.

all the builders will make special widths of machines to order, therefore, any of the different machines may be used.

After the goods are gigged and dried, they are brushed, measured, and cut into suitable lengths for a pair of blankets; the ends where they are cut being nicely bound to prevent raveling. They are then folded. The nap should be nicely straightened by hand, as they are folded so as to have them in the neatest possible condition for the market.

WORSTEDS.

As there are so many different kinds of worsted cloths, this chapter will deal with light-weight and heavy-weight piece dyes. These goods must be made as *perfect as possible in the burling and mending* and then go to the singeing machine for a thorough singeing, after which they are taken to the crab room and put through the usual process, giving them a medium pressure on the top bowl. They are then ready for the scouring process. This is best done with a liquor made of 4% pearl ash dissolved in water, which is about five or six ounces of the ash to a gallon of water. This liquor should be used in the washer, giving about three pailfuls to a piece and adding to this about one-half pailful of a good-bodied fulling soap. The goods should be scoured thoroughly and then rinsed.

As it is not desired to have much lustre on these goods, the *steaming is omitted.* If the goods need carbonizing it may be done at this point, after which they go to the dyehouse. When colored they need a good washing and a bath of fuller's earth, and are then extracted and dyed.

Polishing. The next operation in order is back-burling, but as rubber rest shears are coming into use, this is omitted, so the goods go to the pumicing or sanding machine, of which an illustration is given at Fig. 78. This machine is the most economical to use, as it can readily be turned into a brush by removing the lays covered with sand and substituting brush lays for them. These cylinders being supplied simply with six arms, a space is left between each and this causes the lays to exert a kind of beating upon the cloth.

The purpose of this machine is to polish the face and make the *threads show clearly*, at the same time imparting a soft and

silky feeling to the goods. One or two runs are sufficient for this purpose if the goods have been singed; if unsinged, more runs must be given. The cloth is then ready for the shear.

Shearing. This class of worsteds is *closely sheared,* but should not be scraped. On the rubber rest shear several less runs may be given, as it is possible to go down closer on the goods without doing damage; that is, if the shear is set properly. After shearing, the goods are pressed face up, with good pressure. They

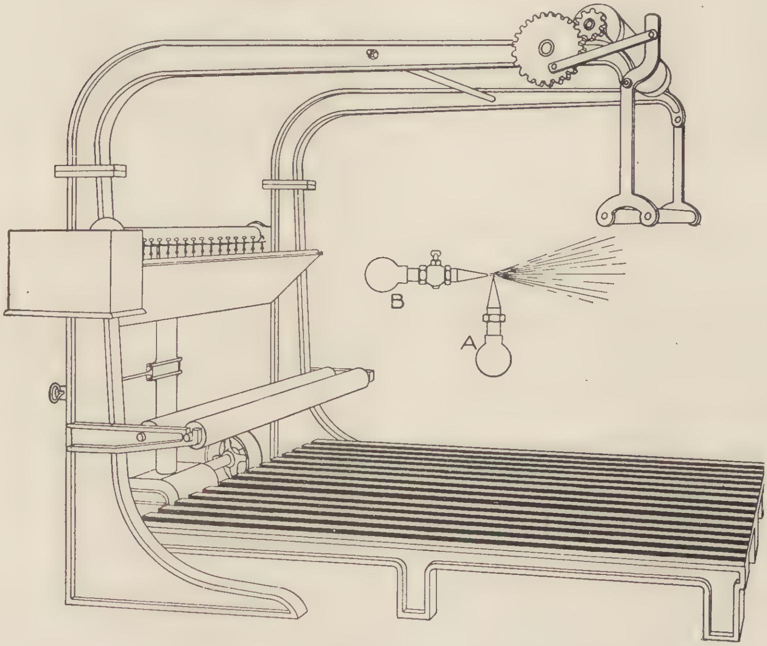


Fig. 79. Kinyon Bros.' Dampening Machine.

are also steamed and rolled upon the press. This process will do for light-weights or simple fabrics.

The heavier goods, or those having a wool back, are also singed, but fulling takes the place of crabbing. They are run in a fulling mill for fifteen or twenty minutes with a good strong soap and are then given a thorough scouring and rinsing. A moderate steaming completes the special processes these goods are put through, and is followed by the operations as in the previous descriptions.

FANCY WORSTEDS.

One of the characteristics of these goods is that they are all yarn-dyed. Some goods which are called fancy worsteds, but really contain more or less cotton threads, are piece-dyed with wool dye, but these belong to another class. Fancy worsteds are often finished without being singed, but this is probably done more because a machine for the purpose is not at hand, than because anyone thinks the process should be omitted.

On account of the colors, the washing has to be *closely watched*, and especially the strength of the soap. If this is not attended to, the more tender colors are likely to be damaged. There is no further departure from the process explained in the last chapter until it comes to the sanding and polishing. This must be very thorough, while the process must be watched so that the goods lose none of their strength.

Dampening. After shearing and brushing as on all goods before they go to the press, it is often necessary to dampen worsteds, and for this purpose the machine which is illustrated in Fig. 79 is employed. The machine is very simple, the dampening being produced by forcing air through one set of nozzles while a drop of water appears at the point of the other. This water is taken by the air and spread as shown in the figure; A being the water nozzle and B the air nozzle. The air is supplied by a fan, and the water is contained in a box or tank at the side. The goods pass in front of the machine, being placed on the scray and passing upward and back to the roll and folder, are folded off behind. This machine is used to give the goods additional weight and also to give them the right feeling, which is not desired to be too dry. From three to six pounds of water per yard can be put on the goods with this machine. The dewing, of course, must be done on the *back of the cloth.* After letting the goods lie a half-hour or so, they go to the press and are treated as previously described.

SERGES.

While these goods are made of worsted, they have a character entirely their own and therefore are generally classed by themselves.

Serges are of rather an open nature, and while they are "made" in the loom, that is, do not require shrinkage in either

width or length other than what will be naturally entailed in the process, they are not as solid as most goods which are "made" there. After burling and mending, which are very important as the goods are clear-finished, they are ready for the singeing process. Where rubber rest shears are in use, the burling on the back is very slight and in many instances entirely omitted

Singeing. The goods are then placed in a pile with the ends laid out, so that the top end of one piece is face up and the bottom end of the next piece is face down. This brings all the ends together, and face to face, and the pieces are thus sewed together, making of the whole pile one endless piece. The object of sewing all the pieces together is to facilitate the singeing process, which must be very thorough. Gas singeing should be used in preference to plate singeing, for the flame of the gas will clear the face of all fibres in the twill which the plates cannot reach.

Crabbing and Scouring. After the singe dust is brushed off, the pieces are taken to the crab room and thoroughly *crabbed with solid pressure*, and then taken to the scouring to be thoroughly washed and freed of all impurities. The scouring process should not be extended too long in point of time, for there is danger of counteracting the effects of the crabbing.

The fact that the heat employed in the second bowl of the crab during the setting process should be as high as that used during any subsequent process has been mentioned before. Few dyers care to boil goods more than is actually necessary for good dyeing, and when goods come along which do not show up clear enough, and where the effects of the crabbing have been practically destroyed, it is usually caused by using too much heat in the scouring process. There is very little dirt in these goods aside from the oil used in the worsted spinning process and the size used when dressing the warps. The latter is well loosened in the crabbing, and is therefore easily removed; for this reason there is no warrant for extending the scouring operation.

After the pieces are properly cleansed they are ready for the dyehouse. After being colored and rinsed with the usual bath of fuller's earth, which should not be omitted, they are ready for the dryer.

Drying. Many finishers look upon the drying as of small importance, but on serges this is an error. They require to be dried slowly, and for this reason the heat should be moderate and the dryer run slowly. On account of the construction being light

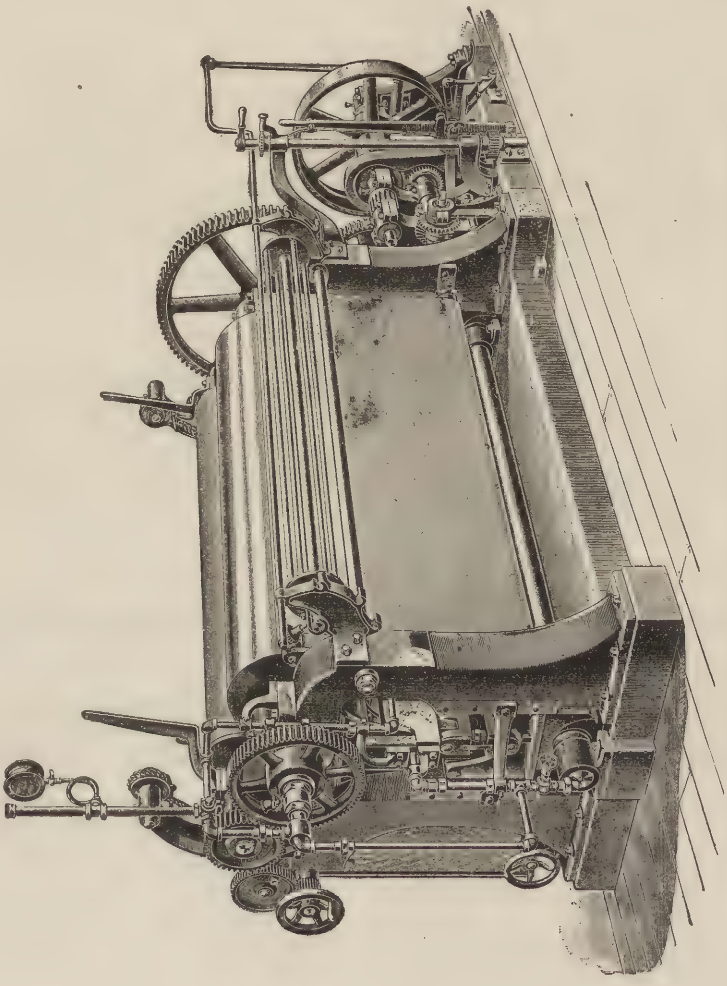


Fig. 80. Gessner's Press with Apron Passing Over and Around the Bedplate.

and open, and therefore easily dried, it is often the case that the dryer is run at full speed, and the heat the same as would be required on 30-ounce goods. By this treatment the goods will become baked and lose much of the silky feeling which is one of the

special features of serges. Much of the harsh feeling sometimes found in goods is due to drying with excessive heat.

In large establishments the drying process assumes quite important proportions, but that is no reason why the goods should be neglected at this point after being carefully treated in previous operations. After the goods are dried they are looked over and specked, after which they are sheared.

Shearing and Pressing. If properly treated up to this point, very little shearing is necessary. With a rubber rest shear they can generally be sheared satisfactorily with one run. They are then taken to the dewing or dampening machine and slightly dampened and are then ready for the press.

The best results are obtained by pressing them on an apron press, of which Fig. 80 is an illustration. The goods are run *face up* and receive a *moderate pressure*. After leaving the press they are ready for inspection and the other final operations.

DRESS GOODS.

Dress goods as such, may be divided into two distinct classes, *i.e.*, *woolen dress goods* and *worsted dress goods*. The nature of the former is such that they usually receive a finish similar to that given light-weight men's wear goods, and therefore do not need any special mention at this time. We will take up the subject of finishing worsted dress goods, as they require a line of treatment which, in many respects, differs radically from finishing woolen goods.

In the finishing of dress goods, the finisher comes in contact with several machines which are not used in the usual line of finishing; although in finishing men's wear worsteds these machines might be introduced with profit. As far as the burling and mending are concerned, it has been mentioned before in these papers that more care is required on worsted than on woolen goods, but on worsted dress goods this care must be increased. This, in a large measure, is due to the lightness of dress goods in general, and also on account of worsted dress goods, with the exception of cheviot serges, being finished very clear. After carefully burling and mending the pieces they are ready for the next step, which is the singeing.

Singeing. As previously explained, two methods of singeing are employed; one being the gas and the other the plate singeing. The machines used for these separate methods have been described, and therefore it is only necessary at this point to discuss the relative merits of the two methods. Each of these methods has its good points, and, where dress goods are finished on a large scale, both ought to be employed.

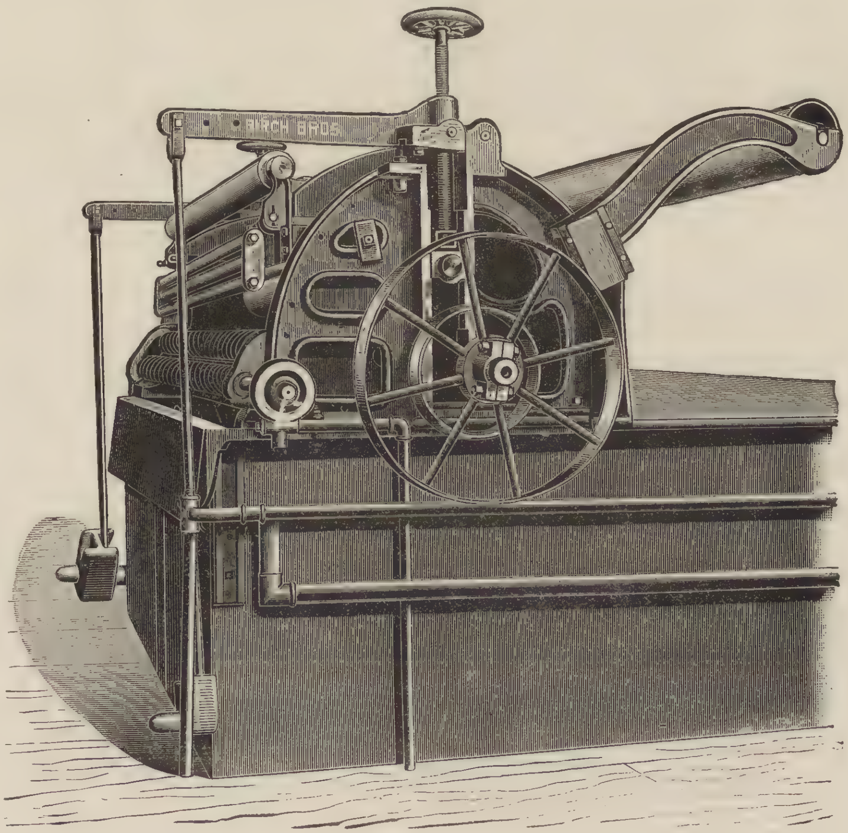


Fig. 81. Birch Bros.' Flat or Open Washer.

Dress goods may be divided into the two classes of *twilled* and *fancy woven goods*. While twilled goods are classed under the common name of serges, they have various names when sold in stores; a serge being regarded as a cloth of open texture. In the mills,

all twilled goods are known and designated as serges, no matter if they are of an open nature or close and fine.

On all twilled goods the gas is more effective and should be used in preference to the other method. On fancy woven goods, such as poplins, gas singeing will, of course, clean them just as well, but for the silky feeling which these goods should have, the singeing over copper plates is of more benefit. It will thus be easily seen that there is really no chance for a controversy as regards the two methods, and while either one may be employed with success, the best results can only be obtained by the use of the method best adapted for the goods under treatment.

Another point should be mentioned here, and one that has not yet dawned upon the makers of singeing machines. This is the use of a brush, in connection with the machine, to brush off the singe dust. This is a very easy matter, and can be done by affixing a brush to the top roll and encasing it in a tin or sheet-iron box, leaving just enough room for the cloth to pass freely. This casing can be easily connected with a suction fan and a conductor to lead all this noxious dust outside the room. On the plate singer a similar arrangement can be made, which will save much work to get rid of the singe dust.

Crabbing. After the singeing has been completed, the pieces are taken to the crabbing machines. When the goods have been treated at the first machine and are ready for the next one, it is necessary to have the water boiling. Some makers of crabbing machines have advanced far enough to facilitate the work to be done here by adding an extra tank, to be filled with cold water. When the pieces have been properly treated at this stage, and are ready to come off, they are run through this additional tank to be cooled off. A low temperature must be maintained by constant addition of cold water.

The washing operation follows, and as the goods must be delivered to the washer at a low temperature, the use of the cooling tank saves the beaming and subsequent unrolling of the goods, besides saving many goods from becoming tender; which is a constant menace when goods are left on rolls to cool off. When the crabbing has been properly performed the weave has become set and there is no danger of the goods felting or shrinking in the washing

Washing. For the purpose of washing, the flat or open washer, of which Fig. 81 is an illustration, is used. This machine has a patent guide and opener, which takes out all creases and

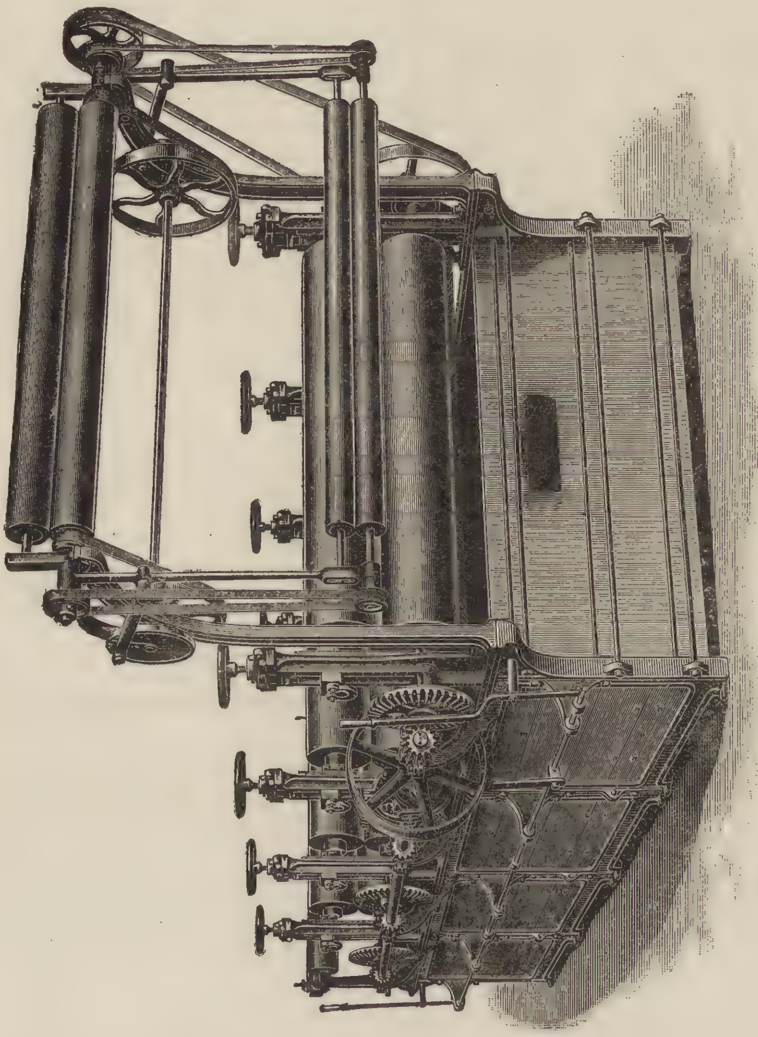


Fig. 82. Birch Bros.' Wet-Finishing Machine.

wrinkles and keeps the goods open and flat during the operation. The machine is also provided with three rolls instead of two as in ordinary washers. The cloth passes through the machine substantially as through other washers, except that the goods are kept

opened out. The manner of washing the goods differs materially from the washing of men's wear goods in that dissolved sizing being the only foreign matter in the cloth, it is simply rinsed out. The addition of pearl ash at the first crabbing-bowl takes care of what little grease or other impurities are present in the goods, and for this reason should not be omitted.

If warm water is used it will, of course, hasten the process considerably, and ensure the lustre and soft feeling which are so desirable. After the washing a bath of fuller's earth is given

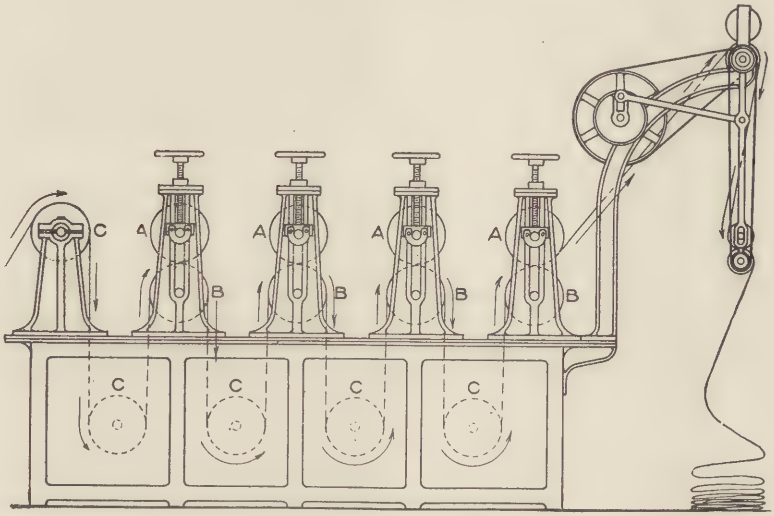


Fig. 83. Side View of Wet-Finishing Machine.

which will liven up the piece and show up the colors better, especially if fancy colors are present. If the cloth is for piece dyes, these also will be much improved by the bath, and be in better condition for the dyer.

Wet-Finishing Machine. The method just described is being discarded, and one of the most important factors in bringing this about is the new wet-finishing machine, an illustration of which is shown at Fig. 82. This machine consists of a series of tanks over which squeeze rolls are set, and also of a number of guide rolls and stretchers. As will be seen in the illustration, the machine is very simple, all unnecessary rigging being avoided. In efficiency it is equal to two crabbing machines. The line drawing at Fig.

83 illustrates the working of the machine. A and B are the squeeze rolls, while all the smaller rolls marked C are guide rolls. The cloth travels in the direction of the arrows.

The usual way to proceed with this machine is to pass the goods into the first tank, which is filled with water at 120° to 125° F. They pass under a roll at the bottom of the tank and then up to and through the squeeze rolls, the pressure on which can be regulated by means of the hand wheels on either side. From the first tank and set of squeeze rolls they pass to the second tank, which is filled with boiling water and are there treated the same as in the first tank. From there they pass to the third tank and receive the same treatment. Then they pass to the fourth tank, which is filled with cold water, and when passing through the last set of squeeze rolls receive a hard pressure, and then pass to the top roll and folder and are folded off in smooth piles.

About five per cent of pearl ash is added to the water in the first tank, or, if this cannot be procured, calcined soda or pure alkali may be used. Either of these latter substances will act detrimentally on the fibre, making it harsh and brittle, therefore, pearl ash is much to be preferred.

When handling fine goods, it is a good plan to give them a light washing with dilute potash soap, and rinse, following with a bath of fuller's earth. This should be done in the washer.

Sorting. Before the goods are sent to the dyehouse, they are carefully sorted over for dark threads, spots, and other blemishes. This is done for the purpose of keeping these imperfect goods from being put in the lighter and more delicate shades.

After the goods are colored they are found to be in string or rope fashion, and therefore have to be straightened out. To do this by hand is at best a slow and tedious process, and would materially increase the labor cost of the goods. For this purpose the opening or scutching machine is employed. (See Fig. 84.) The manner in which this machine performs its work is very simple, but effective, as may be readily seen in the illustration. The cloth comes in a twisted condition, the twist being beaten back by the two-armed beater. From the beater it passes between two spiral rolls, like Fig. 85, which take out any remaining creases or wrinkles. The cloth then passes between two other rolls and thence to the

folder, which folds it off in even piles. These machines should be in every woolen mill, for the tendency to roping and rolling occurs quite frequently, and when these pieces have to be folded out by hand much of the doubled listing is overlooked, causing bad work afterward.

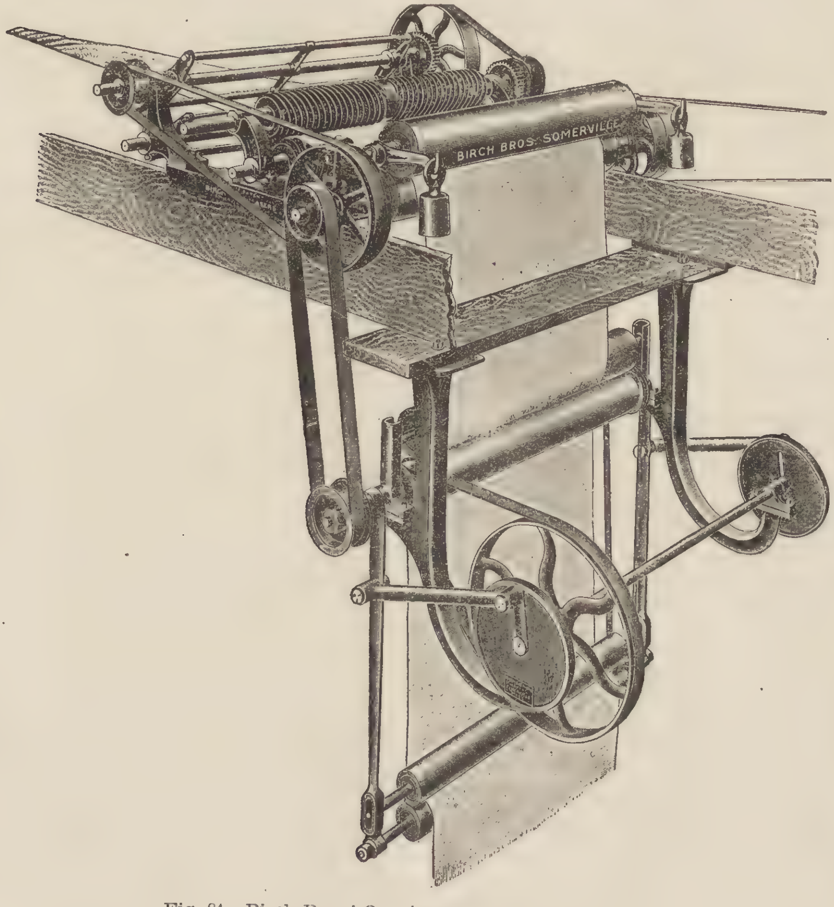
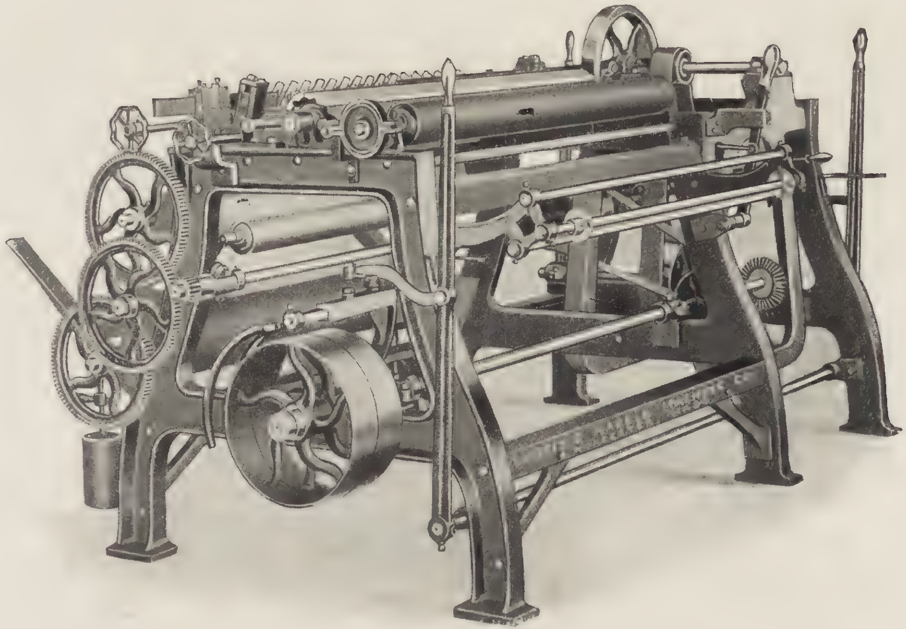


Fig. 84. Birch Bros.' Opening and Folding Machine.

Drying. After the goods are straightened out, they are run in the washer and well rinsed, after which they receive another bath of fuller's earth. They are then ready for drying, which is best done on a chain dryer. The drying should be done more by ventilation than by excessive heat, for the fabric will have a harsh feeling if dried quickly with high temperature.



LOOP CUTTING MACHINE FOR CUTTING THE BRIDGE THREADS ON FANCY SPOT GOODS
Curtis & Marble Machine Co.

The goods should be stretched to bring them to the required width, but if they are already wide enough they should be kept sufficiently stretched to prevent wrinkles, which if dried in the goods are likely to be *cut on the shear.*

After the goods are dried they are carefully looked over, and shades compared with samples so that any difference may be detected before more labor is expended on them. If shades are not right the pieces are sent back to the dyehouse to be made right, but if only an occasional piece is off shade, it is generally laid aside and used for darker shades or black.

The following processes of finishing depend entirely upon the kind and quality of the fabric. Many of the lower grade worsteds do not need any shearing after drying, the singeing clearing them sufficiently to be immediately pressed. Better grades are shorn after drying so as to remove any fibres which may have been raised by the different manipulations of dyeing and finishing, and the shears should be in good condition for the goods must be shorn entirely bare. Rubber rest shears are of great benefit in shearing worsted dress goods, therefore all shears used on such goods should be provided with the rubber tube.

On some classes of dress goods it is necessary to give one or two runs over the polishing machine in order to bring them out clear enough, and this will also help the feel of the goods. The gas singeing machine should be used in preference to the shear on fancy goods with raised patterns, for the shear will not clear the bottom. On goods which require a high lustre it is advisable to sharply steam the goods on the steaming machine, after they are through the wet-fin-

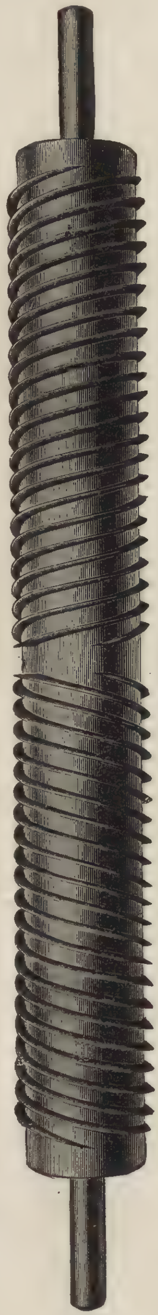


Fig. 85. Spiral Roll.

ishing and before sending them to the dyehouse. In the case of high lustre cheviots, this steaming should be repeated after the goods are dry. When such a second steaming is deemed advisable the goods should be sent to the washer, if an open washer is at hand, and thoroughly rinsed with *cold water.* If an open washer is not used it is best to dry them right after steaming.

Padding Machine. When the shearing and such things are completed the goods are laid out in lots of from twelve to sixteen pieces and the ends sewn together, face to face. This is done to facilitate the work on the padding machine, of which an illustration is shown at Fig. 86. This machine consists of two heavy iron rolls, which are covered very smoothly with cotton cloth. The lower of these rolls is set in a tank so that it may be partially immersed in water or liquor, as the case may be, while the top roll may receive pressure to the desired amount by means of screws and hand wheels. Two spiral rolls are placed in front of the machine, their purpose being to prevent creases and wrinkles.

If goods are of a heavy and stiff nature and have been singed instead of sheared, the tank is filled with boiling water and the goods passed under the lower roll, then between them and finally are either rolled up or drawn up over a framework and folded on to a stand.

When cheviots and storm serges are run through this machine, a *water proofing mixture* is added to the boiling water. This solution consists of alum and lead, and may be obtained from dealers in chemicals and dyestuffs. A certain amount of this water proofing material is put into the water in the tank, and, after being well dissolved, the goods intended for water proofing are run through the solution. Care must be taken not to have the solution too strong, for, if used to excess, it will leave little white spots on the goods after they are dried. Goods so treated will shed water like the proverbial duck, and thus are very desirable goods for stormy weather.

On better classes of serges, that is, the fine and closely woven grades, the goods require a certain amount of stiffening to show off the finish to advantage, and this is accomplished by using a solution of *Irish moss.* This moss, when boiled, forms a gelatinous substance which, when used in the proper quantities, gives the

goods a certain stability and firmness which is very desirable. When wanted for use on thin goods about a pailful of this gelatinous product is added to about fifty gallons of water, and well dissolved by boiling. It is then strained and about four or five pails of this liquor are added to the water in the tank of the pad-

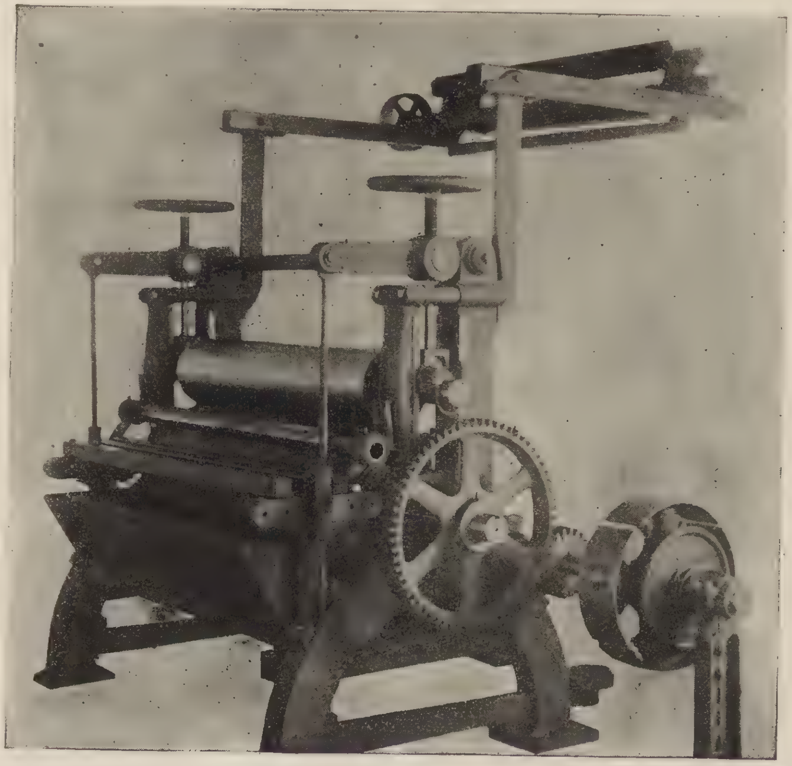


Fig. 86. Two Roll Padding Machine.
Manufactured by Textile-Finishing Machinery Co.

ding machine and the goods run through, after which they are dried. The liquor should be kept near the boiling point while the goods are passing through, or the results are likely to be uneven.

Drying. If the goods are dried on the ordinary tentering machines they will require a separate pressing operation, or rather two pressings; while if the proper facilities are at hand one slight pressing will be enough. To properly treat the goods, a machine is required of which Fig. 87 is an illustration. This machine is

nothing more than a large copper cylinder and an endless felt apron, to which is added the usual stretching apparatus, to get the goods to the exact width. The large drum is heated by steam and the pipe leading to it should have a safety valve connected, to allow the steam to blow off at a medium pressure, for it is not desirable to have too much pressure in the drum.

As shown at Fig. 87, the goods are put on the chain with pins EE, which can be set to width. From there they go on the felt apron C, and travel with this around the drum A, which is driven by a belt on the farther side, and draws the felt along, so that after the goods are once laid on the apron they are not subjected to any friction, but simply pass around with the drum and apron, and are dried in the passage. This leaves the goods as smooth as if they were pressed.

The guide rolls *b b* are only for the felt apron to pass over. After the felt leaves the drum the piece is taken to F, the top roll, and G, the folder, and is nicely folded off. The wheels D D carry the chain and can be adjusted as the width of the goods require. This varies from 33 to 50 inches, for dress goods are seldom made wider than 50 inches, except storm serges, which are often made 54 inches wide.

Pressing. The pieces are then taken to the press room and doubled *face out* and put in papers. The press papers used here are somewhat narrower than those used on men's wear, and when the pieces are put in the papers, or rather the papers put in the pieces, they are only put on the face of the goods. This makes papering up these goods much simpler. After the papering process is completed the goods are put in the press and generally pressed cold. Lustre goods are the exception to this statement, as they require to be hot pressed. After being in the press about five or six hours, the goods are taken out, and after removing the papers, are sent to be examined.

The *final examination* on these goods differs from that on men's wear in that they are not drawn over a perch; but are laid on a table where there is a good light, and the several folds are turned over and closely examined. When the end is reached the piece is turned over and examined on the under side. All imperfections are marked with a gum label and the allowance written on

this, instead of putting in a string as on men's wear goods. After the goods have been carefully examined they are measured and rolled, or folded up ready for the market.

To conclude, attention is called to the necessity of using sewing machines on dress goods whenever the ends need sewing together. This is not only necessary on account of the time thus saved, but on account of the lightness of the fabrics. A cut of one of these machines is shown at Fig. 88. The sewing part of this machine is the same as on any other chain-stitch machine, but a new principle is made use of in the large wheel in front. Pins

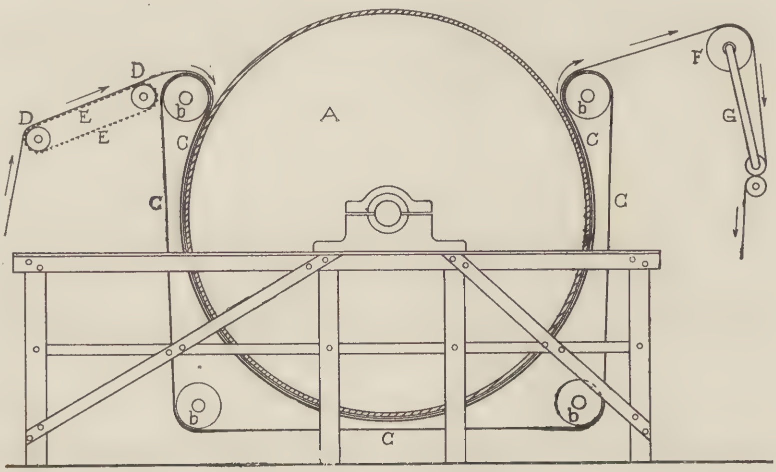


Fig. 87. Drying Machine.

are placed on the surface of the wheel, and the cloth is hooked on the pins, thus using the wheel as a feeder.

POPLINS.

There are very few styles of dress goods which have retained their popularity as have poplins, or reps as they are sometimes called. The true merit of the weave is perhaps the reason why they have kept such a firm hold on the favor of the buyer. This is gratifying evidence that true merit is able in some instances to overcome the dictates of fashion. For instance, in England, which was at one time the only place where reps were made, they have been the most popular fabric for ladies' dresses for generations.

To insure a moderately perfect fabric the goods are first taken to the open washer and washed with a light soap and pearl ash liquor. They are then dried, and are ready for the burling. The *burling and mending* can be done much easier by first subjecting the goods to this washing operation, and also can be done more thoroughly. On the lower grades the washing need not precede the burling and mending. Care must be taken when washing the pieces not to extend the process too long, for the weave has not yet been set, and if goods run long in the washer, they are apt to be "wooly" and lose much of their good feeling qualities; which it is impossible to re-impart in any of the later processes.

After the mending process is completed the goods are *singed*, and for these goods plate singeing is the best method. Plate singeing, as has been explained before, imparts a certain smooth and silky feeling to the goods, which cannot be obtained by singeing with gas. After singing, the dust is removed by means of brushing, unless this work has been done on the singeing machine, as it should be.

Crabbing. The goods are then ready for the crabbing process, and it may be stated that the continuous wet-finishing machine is much to be preferred for the finishing of these goods. Generally, enough attention is not paid to the best means of doing the work, and instead of regulating the machines to conform to the work to be done, the practice is to regulate the work according to the machine at hand. This proceeding is entirely wrong, and it can be easily seen that if one man finishes certain classes of goods with the machines best adapted to them, it will be an easy matter for him to produce a better finish, with less trouble and labor, than another man who has to adapt his method of finishing to machines unsuited for the work. As the product of both places enters the same market, the better finished piece of cloth, of course, finds the readier sale, and at the better price.

As it is more than likely that the student will encounter in actual practice many instances where machines have to be used to produce a finish which are way behind the times, it will pay him to study the methods on the old as well as the new machines, so as to be able to turn out commendable work no matter what kind of machinery he encounters.

If the *old-style crab* is used, the pieces are run on the first bowl under moderately hard pressure for twenty minutes, then beamed off and the roll stood on end for at least forty minutes. The goods are then run on the second bowl and receive twenty minutes in boiling water, under heavy pressure. When ready to be taken from the second bowl they are passed through a box filled with cold water, or if this is not at hand, are beamed off the crab roll on wooden rolls and left to cool. The method of cooling in water is much to be preferred, in fact it would be better to take the goods to the padding machine and there run through cold water, than to let them cool on the rolls.

If the goods have been washed before burling, they are now ready for the dyehouse, but if not, they go to the washer and are thoroughly but quickly washed. Before sending them to the dyehouse, they are submitted to the usual examination, that is, if they are for light and delicate shades; if for blacks they are sent to the dyehouse without this examination. After the pieces are colored they are opened and folded on the scutching machine. When dry the usual inspection takes place for the purpose of comparing shades, etc., after which they are ready for the shear.

Shearing. These pieces must be sheared very clean, so a few runs on the polishing or sanding machine will be beneficial. However, it often happens that the goods come in such condition that it is impossible to clean them properly on the shear, even with the aid of the sanding machine, and when this is the case, they should be *thoroughly singed* on the gas-singeing machine. The singe dust is then removed and the goods taken to the padding machine and run through hot water, then dried on the machine illustrated at Fig 87

The various shades passing over this machine, although clean, will in time leave the apron stained, so it is advisable to dry the more delicate shades, such as cream, rose, and light pink, on the chain dryer and then press them on the apron press. After that the pieces are taken to the press room and pressed hot for about six hours. Final inspection, measuring, etc., complete the operation.

WORSTED CHEVIOTS.

The *burling* and *mending* operations are performed with the usual care, for the absence of a fancy thread, particularly in the

plaids, is easily detected. The pieces then go to the fulling mill, and, as they are made quite wide on the loom, are shrunk to width and length according to requirements. A good bodied soap is needed, but too much alkali should not be used or it will spoil the fancy threads.

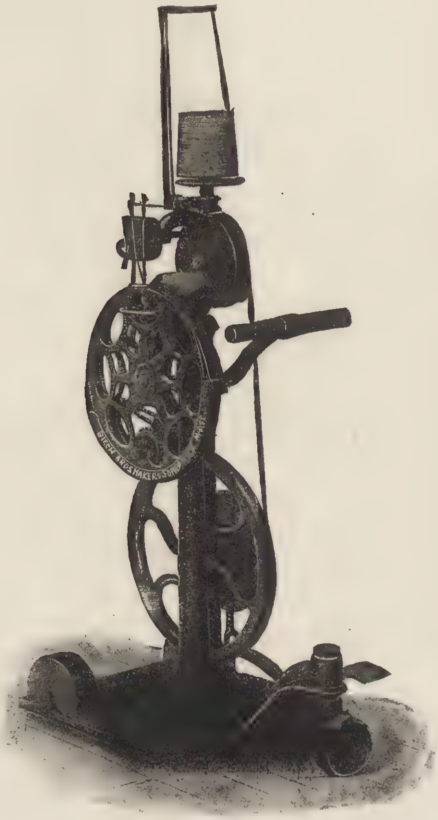


Fig. 88. Birch Bros.' Sewing Machine.

After washing, which is conducted in the usual manner, the goods are extracted and folded, and then run on the steamer. They are steamed for about five minutes on each cylinder, the brush being set off so as to touch the pieces very lightly. They are then ready for the dyeing and subsequent operations. On the press they are run *face down* so as to add to the lustre, and enough steam is used to take off the press glaze.

When piece-dyed goods are handled they go from the steamer to the dyehouse, and upon returning pass through the usual after-processes.

BLEACHING WOOLEN GOODS BY THE SULPHUR PROCESS.

The bleaching of woolen goods by the sulphur process, although in itself a very simple process, is attended with many apparently slight but important details. The fact is well known to all finishers that the lighter the color of the goods the more plainly will all little imperfections show up. On white goods every little speck is sure to assume very large proportions, simply by reason of the contrast. It is, therefore, of the utmost importance that the proper stock be used in goods which are to be finished white.

Stock. There is no use in trying to produce a good piece of white goods if the stock is at all "burry" or has much vegetable matter in it. Even if the labor cost is increased in trying to bring such goods out right, they will be unsatisfactory. We will assume that this part of the work has been carefully attended to and the proper amount of care, necessary for good results, has been bestowed upon the stock in the various processes through which it passes before becoming a piece of cloth.

Washing. The washing should be very thorough, not omitting the rinsing, as it is essential that all soap be removed. After the pieces have been carefully washed and thoroughly rinsed, and before anything else is done to them, they should be *carefully examined* and all those pieces which do not come up to the standard should be laid aside to be dyed. To do this thoroughly the pieces should be drawn over a table and every spot taken out if it is possible to do so. After the goods are bleached these little things will show up and mean an allowance, if nothing more. Very often a stain cannot be removed in the washing process, but when taken separately in this way it can be taken out with strong soap.

This may be considered as rather too much bother and to entail too much cost, but it must be remembered that white woolen goods are only of the finest grades and that this labor will pay. Right here it may be pointed out that the more care taken in the

selection of the stock, the less the cost will be for this item. If creditable goods are desired, do not omit this examination.

Extracting. When the goods have thus been carefully looked over and everything corrected which it is possible to correct, they may be finished in the usual manner up to the process of drying. Before they are put into the extractor it is good policy not only to thoroughly wash the machine, but also to use a sheet over all exposed parts, so that the cloth may not come in contact with the ironwork of the basket. This precaution is of much value, and as it is not costly it should in all cases be adopted for white goods. After the pieces come from the napper or gig, they are carefully wrapped in sheets and are then ready for the bleaching process.

Theory. The process here described is the method of bleaching woolen goods by the use of sulphurous acid gas. This gas is produced by the burning of sulphur, the fumes of which are *sulphurous acid gas.* The goods are exposed to this fume or gas long enough to remove the varnish-like matter which adheres to the fibre, and which cannot be entirely removed in any other way. Much of this substance may be taken off by treating the goods to a strong bath of sulphuric acid, but the acid does not produce that whiteness and clearness obtained with the sulphurous acid gas.

According to Thom's sulphuring process, the goods are passed on a long chain up and down over a series of rollers which are placed in a small chamber, and this chamber is filled with sulphurous acid vapors. In a short time the goods are thoroughly bleached.

Operation. To avoid the expense of a bronze chain for removing the cloth, two rails are run lengthwise about a foot from the ceiling and about six feet apart, and a number of square sticks about six or eight inches longer than the distance between the rails, and about one and one-half inches square, are placed across the rails. Enough of the piece is folded to reach from the rails to within a foot of the floor and one of the sticks passed through the fold and placed on the rails. This operation is repeated until the pieces are all strung up and the chamber is filled.

The sulphur is placed in an iron vessel, in which some live coals have been placed, and this is put in a corner. The sulphur

will ignite readily and in a short time the fumes are so dense that the operator has to leave the chamber. The pieces are left for six to twelve hours according to the time at command. Where the production of white goods is continuous it would be much the better way to use a bronze chain, but where white goods are only made periodically, and then in small quantities, the plan described will answer very well.

The chamber in which the sulphuring is done should be made as *tight as possible* to prevent the fumes from escaping, not alone on account of the bleaching process, but also because of their deleterious effect on all animal and vegetable life. The bleaching is performed much more evenly and satisfactorily if the goods are put in the chamber in a moist state, although care should be taken that they do not contain sufficient moisture to drip, for this is apt to make the bleaching uneven.

When possible, it is best to fill the chamber at night, that is, just before quitting time, and thus have the bleaching done over night. Put in sufficient sulphur to burn for about four hours, as this will give enough vapor for the process. Then in the morning open the doors for two or three hours before the goods are to be taken down, for otherwise it will be impossible to work in the room. When the goods are to be taken down, the floor should be well covered with clean burlap, when the pieces may be pulled down, tied up, and taken to the dyehouse or wash room, or wherever the next process is to be performed.

Bluing. So far as the bleaching process is concerned, the foregoing description covers it completely, but that is the simplest part of the process, at least for those goods which are to be finished white. Such goods as are bleached for the purpose of enabling the dyer to produce brighter colors, as, for instance, cream, light pink, rose, etc., are sent to the dyehouse, but pieces which are to be finished white will have to be submitted to a bluing bath, which gives them a more attractive appearance. Then also a very strong odor of sulphur adheres to the goods, and this has to be overcome.

The pieces are first placed in a clean washer and thoroughly wet down and drained, after which the gates are closed and the washer filled half full of a solution of two per cent soda, which gives about two pounds of soda for every twelve gallons. Let the

goods run in this liquor for about twenty minutes, then rinse for ten minutes with a good stream of water, and follow with the bluing process.

Operation. Very often the bluing process is carried on in the washing machine, but this method cannot be recommended, for the goods are too crowded for the bluing to take hold evenly. A flat or open washer is better, but on account of the trouble experienced in feeding on the bluing, the best plan is to use a dye kettle with a single reel or drum, passing the goods over this, opened to their full width. Not more than four pieces should be blued at a time, as more will crowd the goods too much and make it harder to keep them open. Fill the kettle with sufficient water to cover the pieces, and after they have been around once or twice, commence to feed on the bluing. There are many good articles made especially for this purpose, any one of which will give good results if proper care is taken. Feed the bluing on *slowly and evenly*, and then allow sufficient time for the pieces to go once or twice around.

It remains for the individual who has to do the bluing, to learn through actual experience just how much to give the goods and how long to let them run, for these things do not conform to hard-and-fast rules, and what may work well on one set of pieces may not do at all on the next. Let the operator, through experience, determine how much bluing he can put on with safety, and when this amount has been given and the goods have run through once or twice, let him take a small piece from the end of one of the pieces, and after squeezing it out well, compare it with the standard sample, which, of course, has also been wet out, for there is no use trying to shade a wet piece with a dry one. It can be easily seen whether more bluing is needed or not. As soon as the sample taken shows that the goods have enough, lose no time in taking them out and extracting.

Drying. It does not pay to have white goods lie around any length of time after they have been blued, and for that reason it is well to have everything in readiness so that they can be dried at once. The up-and-down chain dryer is best adapted for these goods; but no matter what style of dryer is used it must be as clean as possible. All iron bars over which the goods have to pass should be wrapped with white cotton cloth.

There is a style of chain dryer in use in many places, in which the cloth travels horizontally instead of vertically, and on this style especial care is needed to keep the goods from coming in contact with the pipes. Where the cloth runs vertically there is not much danger of this trouble, as the pipes are usually in the bottom, below where the cloth travels, and the air is forced by means of a fan. It is a good plan to have racks made of white wood slats and placed on the steam pipes, both top and bottom, so that in case the goods should sag they would come in contact with these racks.

FACTS WORTH REMEMBERING.

Many things which are worth remembering often escape our attention, and especially is this true of various small matters in the manufacture of woolens. Considering the truth that this world is made up of small things, and that each and every one of them has its peculiar importance, it is well that these little things be remembered.

Most of the points in finishing, which require attention, have been again and again emphasized in these pages, and at this time some of the things the finisher should know and remember, but which are outside of his department, will be mentioned. These are the relation of the previous processes to the finishing process and their influence upon its results. While, in many instances, it is beyond the power of the finisher to control or alter any of these previous processes, still a fair knowledge of these things may aid him somewhat in judging the probable cause from the effect.

The influence of previous processes upon the finishing of woolen goods is of great importance, in so far as many defects manifesting themselves in the finished product are often laid at the door of the finisher. The first is the *oiling of the stock* in the picker house. Where this is done by hand it is often done carelessly, unless the help is closely watched. If done carelessly or unevenly, a difference in the finished product will be noticed, and usually shows in shades, but as these shades will be mostly in the filling, it may be determined easily. If the goods shade well from side to center—but there is a difference from end to end—in most cases the above may be looked to as the probable cause.

If the stock goes to the picker house in a *moist condition*, there is cause for future trouble, for if it is even slightly "burry" and is not thoroughly dry before it goes to the picker house, not even a burr picker will clear the stock, with the result that the finished cloth will contain large numbers of burrs. This makes it necessary for the finisher to use stronger burr dye, with the consequence that the shade will be somewhat darker. The finisher will be blamed for this every time.

The dyehouse often turns out uneven work and sometimes tender goods, but the dyer will fight as long as possible against admitting his department to be at fault; therefore, the finisher should remember to *test goods for strength* before sending them to the dyehouse, and again immediately after they are returned.

The card and spinning departments being so closely related, they may here be treated as one. Any difference in the size of the yarn is sure to create bad work which cannot be remedied, therefore the finisher should not be blamed for bad work caused by uneven yarn.

The worst trouble of the finishing room may be caused in the card room. In cold weather it is often difficult to keep down the electricity in the card room, and one of the many ways to overcome this difficulty is by the use of alum. This is applied by dissolving a small quantity in water and sprinkling it over the stock, and while very effective in overcoming the electricity, is just as effective in making trouble for the finishing room. What alum will do may be illustrated by taking a dipperful of good fulling soap and adding a small piece of alum, then agitating the mixture until the alum is dissolved, when it will be found that the whole has assumed the appearance of curdled milk, which is due to the *soap being disintegrated*, leaving the fatty matter as a gummy, sticky substance. If alum will cause this change, it is reasonable to suppose that if it is allowed to permeate the stock in the carding process, it will have the same action upon the goods after they are made up from stock so treated.

The writer has seen a finishing room rendered useless by this proceeding, and it cost many dollars before the trouble was finally located and stopped. The only way to overcome such a thing and finish goods which contain such stock, is to properly *neutralize*

the alum before attempting to full the pieces. This is done by running the goods in the washer in a bath of alkali solution made of four ounces of alkali to the gallon of water. Pearl ash, if it can be obtained, is better still, and of this three ounces will be enough. Each piece should be given four pailfuls of this liquor and run for about an hour, the liquor then being drawn off and the goods rinsed for about ten minutes. This is followed by a thorough scouring, after which the goods are dried, and then fulled in the usual way. This will extend the fulling process somewhat, but that cannot be helped under the circumstances.

In the weave room several causes work together to produce bad and uneven results. If the filling is light, the goods will take more picks, or if the picks are not increased, the cloth will shrink more, which, in the end will amount to the same thing as putting in more picks. Suppose the filling is light and the weaver does not notice it, the piece will probably weigh somewhere near right. But take another piece woven with filling a trifle on the heavy side, and therefore a little heavy when taken from the loom, and finish both pieces the same. The result will be that they will not look alike. If another weaver on the same goods gets light filling, and is careful not to put in more picks than he gets paid for, the pieces are sure to be light and a third difference in the finish will be noted.

These instances are quoted to show that the finisher must be on his guard constantly, and also must remember that not only must bad work be avoided in the finishing room, but *bad work of previous processes should be rectified* if possible.

During the hot months the finishing room requires more than ordinary care. The flocks, being moist, have a tendency to become excessively heated in the summer months, if extra attention is not paid to them. The soap should also receive special attention, and any tendency to produce an excessively high temperature in the mills should be carefully looked into, to see if the soap does not furnish part of the cause.

Free Caustic, if present in the soap, is apt to cause trouble at any time of the year, but more especially in summer when the conditions for overheating are favorable, is the presence of free caustic likely to work mischief, while the trouble is laid to

some other source. Free caustic in hard soap is easily detected by the taste. If present in quantity to do harm, it will disclose itself by a slight burning sensation on the tongue, which, in a neutral soap, will not be noticed.

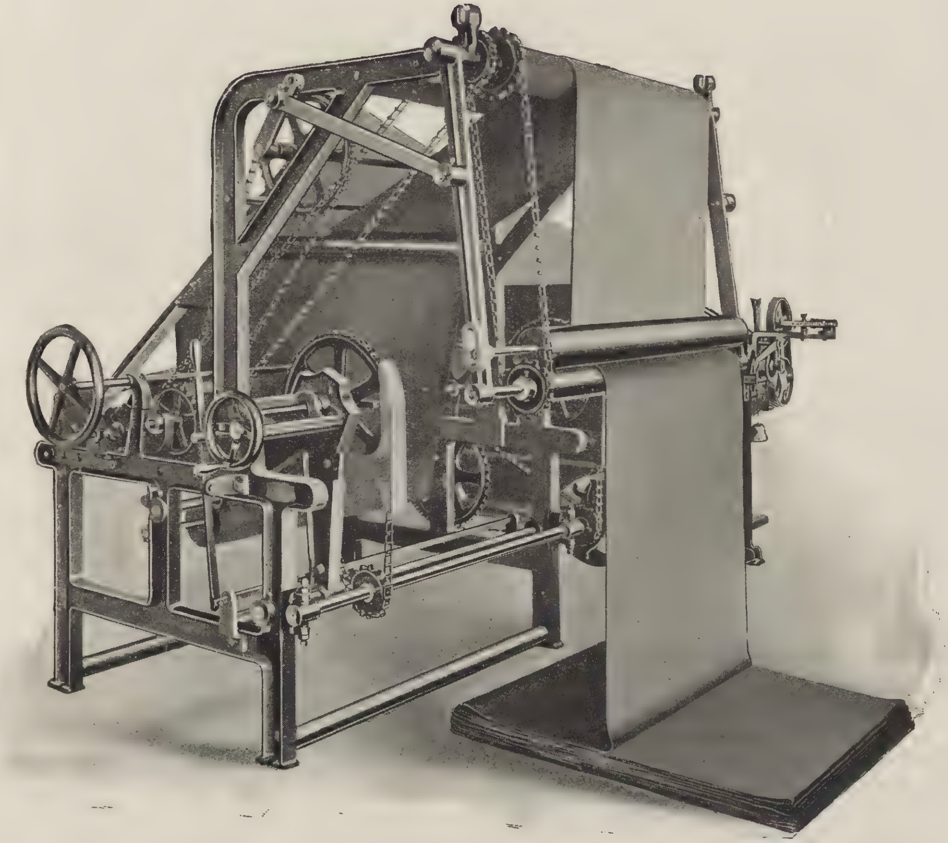
Extra attention is required to keep the temperature in and around the fulling mills as low as possible, and when the goods are taken from the mill, they should be *immediately opened out* to be cooled by the air. If the goods are allowed to lie around in piles awaiting their turn at the washer, there is apt to be lots of trouble from stains, when, by opening the pieces properly, much if not all of this danger is removed. If the goods are examined over a perch before being sent to the washer, the air will cool them off in good shape.

If goods come out of the fulling mill the last thing at night, when it is impossible to get them into the washer to be cooled by water, they should be opened out in good shape and cooled by being pulled over the perch. While the practice of leaving partly fulled goods in the mill over night is poor policy at any time, it is folly in the summer season, and should not be tolerated.

The speck dye should be closely watched in hot weather if the finisher would avoid making "seconds." The dye at this time of the year should be made of a strength to require a great deal of reducing with cold water, and the goods and water for rinsing should be cold.

The flocks from the gig and cropping shear are moist; therefore, if they are allowed to lie in piles they will soon heat. This unfits them for further use, for when flocks commence to heat they turn sour, and it is impossible to remove the sour odor. When such flocks are used on cloth this odor will be imparted to it and no amount of washing or scouring will entirely remove it. This shows that care is required to prevent such a state of affairs. All mills are not fitted to dry these flocks handily, but a sheet can be obtained, and if the flocks are spread on it, they may be easily dried outdoors.

Where face goods are handled, and where it is an object to have them lie in wet piles, they should be frequently overhauled so that they may not heat too much.



66½-INCH MEASURING, DOUBLING AND ROLLING MACHINE WITH FOLDING ATTACHMENT IN OPERATION

Parks & Woolson Machine Co.

CUTTING WASTE MATERIAL INTO FLOCKS.

In many mills there is a good deal of fair stock going on the refuse heap, which might be used to advantage or be disposed of at a profit. This applies to a large part of the flyings swept from under the looms and to most of the flocks made by the fulling

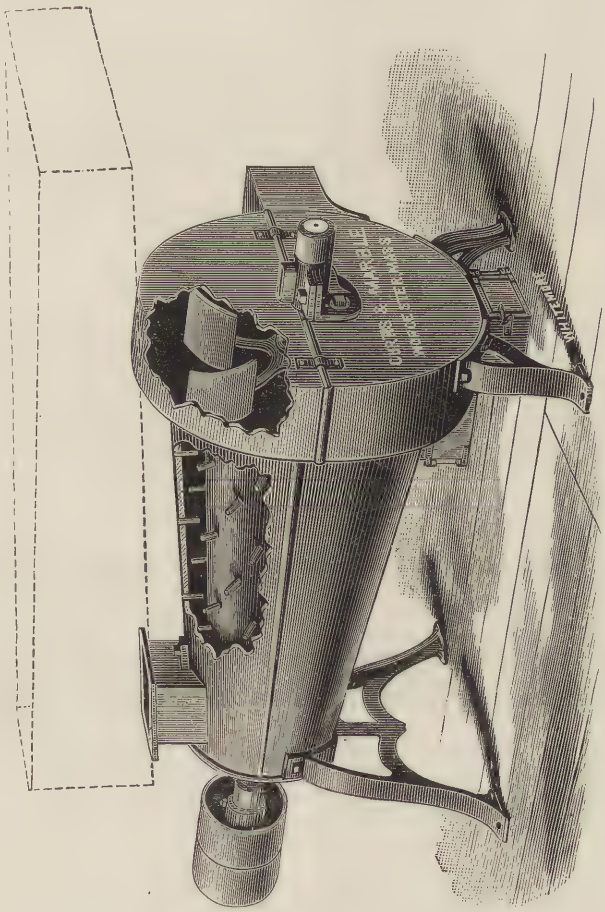


Fig. 89. Curtis and Marble's Flock Renovator.

mills, most all of which should be carefully collected and cleaned.

Flock Renovator. A machine for this purpose is illustrated at Fig. 89. This renovator is used for cleaning stock to be used for flocks. The stock is fed into the small end of the machine from the hopper, as shown by the dotted lines, and after being

opened is blown through the outlet at the large end by a fan. The machine is usually arranged to blow the stock into a small room partitioned off for this purpose. All nails, pieces of iron, and other foreign substances which may be contained in the stock, fall into a receptacle near the bottom, thus leaving nothing in the stock that might injure the blades of the cutter when the stock is cut up into flocks. If flocks are not used in the mill, a readier sale and a better price can be obtained after the stock has been treated in this manner.

Flock Cutter. For the purpose of converting this waste material into flocks, a flock cutter is required. An illustration of one of these machines is given at Fig. 90. The stock is run through the renovator as explained above, which mixes the several kinds in a thorough manner. It is then moistened by sprinkling it with soapsuds and beating in the suds with sticks. The stock is then ready to be cut, so is fed into the flock cutter by a hopper similar in shape to the one illustrated on the renovator.

Operation. The flock cutter has an inlet near each end of the cylinder, and an outlet under each inlet. When the cutter turns in one direction the inlet on the right may be open and the outlet under it closed, the stock leaving by the outlet on the left. When the cylinder is reversed, as is necessary after a few days' cutting, the inlet and outlet are also reversed. The bed blades are adjustable so they may be kept in the proper relation with the cylinder to cut the stock in the best manner. Care should be taken not to bring the blades together too hard. The usual way of reversing the cylinder is by using two belts; one a straight or open belt and the other a crossed belt, changing according to the direction in which it is desired to run the cylinder.

The *flocks should not be cut too fine*, for then much of their value is lost. To be sure they will go on the goods better, but they will also come off better, and generally most of them will be evenly distributed over the floor and tables before the goods have a chance to leave the mill. The remainder may be found in the linings of the garments made out of such goods, shortly after the articles are bought. Most of the flocks bought in the market have this objectionable feature, and unless the stock is of more than usual felting capacity, such flocks will surely act in the above

quoted manner. For this reason alone, a finisher would find it to his advantage to cut his own flocks, for he would be able to cut them of a length that would be of benefit to the goods.

Adjustment. After the machine has run for some time, the blades wear down, which is due in a large degree to the fact that

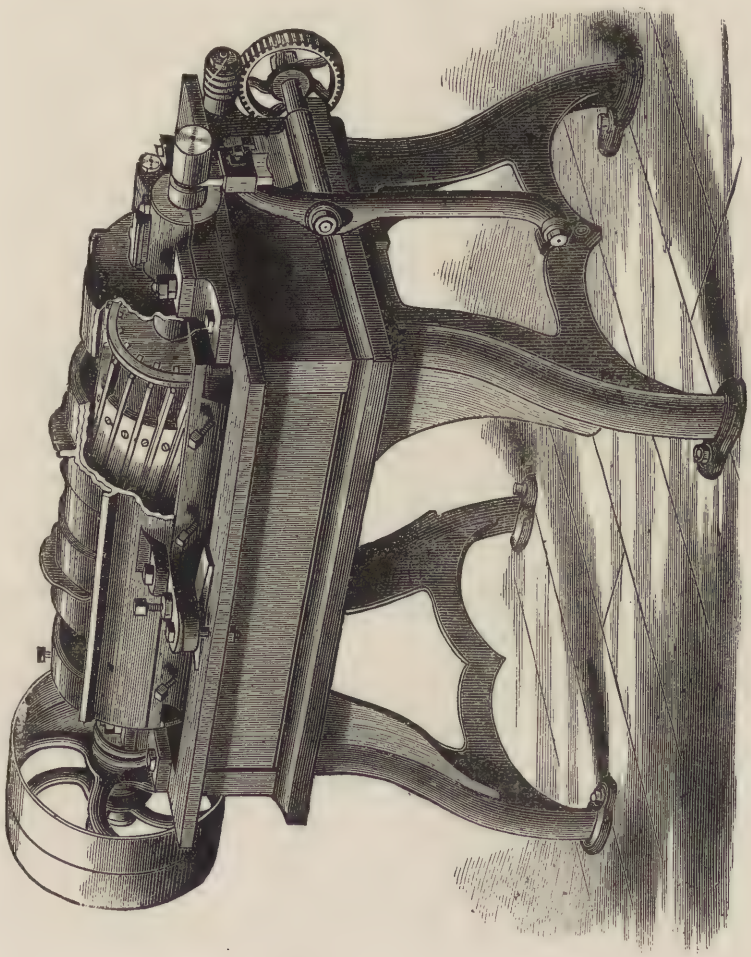


Fig. 90. Curtis and Marble's Flock Cutter.

the machine is self-sharpening. In time the knives of the cylinder and the bed knives become so worn that they will not cut. Upon examination it is found that the knives of the cylinder have wooden lags screwed between them, and when the knives wear

down to the surface of the lags, the cutting will be somewhat like grinding. This must be avoided, for stock that is ground into flocks is of no value, the grinding destroying what little felting capacity it had. When this condition has arrived, the lags of the cylinder are taken out and planed down enough so that about a quarter of an inch of the knife will be exposed.

The blades at the bed also need raising, and for this purpose the bed is let down about one-quarter inch from the cylinder, then the cylinder is taken out. An instrument known as a setting bar and furnished with each machine, is now fitted into the two bearings of the cylinder and adjusted so that the pointer will show the exact size of the cylinder. The screws are now loosened, which releases the bedplates, so they may be adjusted by means of screws found underneath. Each blade is brought up to the pointer for its entire length and when all have been adjusted, the screws are again firmly screwed in so as to hold the blades in their position.

Grinding. In ordinary usage the cylinder and blades seldom need grinding, but when the blades get worn down and the bottom blades have to be reset, the two must be ground together. If the knives become roughened by having nails or hard substances get between them a grinding is necessary. This is usually performed much after the manner of grinding a shear with emery and oil, except that a much coarser grade of emery can be used. But after all, this is a slow and tedious process, for the blades are thick and the grinding cannot be hurried for fear of drawing the temper, which, with such a large surface, is easily done. When the plates are well ground together the machine is cleaned and the cutting operation can begin again; taking care to commence cutting with the cylinder running in the opposite direction to what it did while being ground.

Another method of grinding is as follows: After the blades have been regulated and the cylinder put in place, the cover is put down and secured. A pailful of sand is poured into the machine and the inlets and outlets closed, after which the machine is run for an hour, gradually drawing up the bed. The sand is then let run out, and fresh sand mixed with common machine oil is poured in. This is run for one hour, and is followed by a third application of sand, mixed with a large proportion of oil. This mixture

is run for half an hour, when more oil is added and the grinding completed in another half hour. The machine is then cleaned out ready for use; having done in three hours what would take a day by the former method.

When grinding or cutting flocks the cylinder should vibrate, and for this purpose the vibrator, which is found at the right end of the machine, must be looked after and kept well oiled. When the machine is in good condition and care is taken to reverse the cylinder when necessary, it will do good work. Care must also be taken when feeding the stock that no hard substances get into the machine.

Thus all waste stock may be well taken care of, and even headings can be easily converted into flocks if the price paid for them is not as good as can be obtained for the flocks; besides providing a better grade of flocks for use in the mill.

CONCLUSION.

As a rule the different subjects treated in these pages have been treated in detail, so all that is required here is a few words as to the general management of the finishing room.

The only way to obtain success is to hold the help rigidly responsible for all work entrusted to their care. Never entrust a delicate piece of work to anyone unless you are sure he is able to perform the work satisfactorily. By holding each hand responsible for the work entrusted to him, and making it his duty to examine each piece for damage, and *to report it*, much trouble may be averted and the right person blamed for mistakes.

The help should be made to understand that all tools and other appliances cost money, and are to be handled with due care. Wrenches, trucks, and barrows will last much longer if handled carefully than if they are slammed around, and it is not any harder to handle them carefully, nor does it take any longer. Insist upon having a proper place for everything, and have *everything in its place;* this applies not only to tools but to the goods in process, which often have to await their turn for the next operation.

When this is done the overseer will not have to go around and ask what this or that pile is for, but will know without asking.

These simple points together with courteous but firm treatment of the help will go far towards success.

The different modes of treatment as advised in these pages have all borne the test of actual trial and have been found to give satisfaction, but it must always be taken into consideration that circumstances alter cases, and what may work well in one place and with one man may not with another. *Study the goods well* and make up your mind to a certain mode of treatment, then give it a fair trial, and during such trial you may be able to see wherein your deductions were right and where wrong, and alter the treatment accordingly. No man can go into a new place and make a brilliant success off-hand, no matter what his experience may be; he must carefully study the goods and see how they act in the different processes. Always consider carefully what you are going to do, and in most cases there will be nothing to regret.

The quality and quantity of work produced with specking and burling irons, although in a large measure dependent upon the hands that use them, is still in just as large a measure dependent upon the condition of the irons. A good specker or burler will perform good work with poor irons, but not the quantity that she would produce if the irons were in the proper condition. If this line of reasoning is applied to the poorer class of speckers and burlers, it is at once apparent that if a good hand can do less work with poor irons, a poor hand will perform still less work with them.

The type of iron most in use is the "Lingard," which is the old-fashioned pair of tweezers found in every mill in some form or other. These irons may be used with advantage for both the burling and specking processes, but it will not do to have them in the same condition for both kinds of work. If the iron is fixed in a manner to aid the burlers to do their work quickly and thoroughly, it will be of little value for specking purposes.

For burling, the chief use of the irons is to pull out threads, bunches, knots and so on, and the larger surface there is for this purpose the better. The sides of the irons are usually used for these purposes, the points being used more to pick up knots and runners.

Of course on fine goods, where care has to be exercised so as not to disturb the combination of the several threads, the points

of the irons are used to a greater extent, but even then the shape of the point does not receive much consideration. Most of the work during burling falls on the *sides of the irons*, and it is necessary to have them *sharp*, so that when a thread is taken hold of, it will be partly cut.

At the specking table, a different condition of things is met, for the object to be removed is a small speck, which must be taken out without disturbing the surrounding surface. As shown in the explanation of burling, the larger the surface of the iron, the more it will take hold of, therefore in the case of a speck, which as the name indicates, is very small, it is not necessary to have such a large surface on the irons. In fact, the reverse is the case, for the finer the points of the irons, the easier it will be to get hold of the speck.

If the speck is taken hold of in the proper manner, and with properly fixed irons, one lift should remove it in a neat manner, whereas if the points are large, many of the surrounding fibres will be disturbed, which leaves the cloth in a condition almost as bad as if the speck had been overlooked. Very often it is necessary to send such pieces back to the shear to make them passable, while the operator gets blamed for a condition that she has not the power to prevent. The ends of the irons for specking should be brought to *fine points* well tapered and well smoothed, and of the *same length*. If irons are fixed in this manner the speckers will do more work and of better quality than if the irons are neglected.

There are many other little things in the finishing room that should be looked after in the same manner, for it should always be the overseer's object to find these "little things" and improve them in such a manner that the help may be able to do the most work consistent with the highest quality.

FINISHING COVERT CLOTHS.

On account of the steady demand for Covert Cloths they have assumed an importance which makes it especially desirable for finishers of woolen goods to thoroughly acquaint themselves with the best methods of handling this class of fabrics in the finishing department. The finish which usually is given does not differ

materially from that which is used on face finished cassimeres, in fact, coverts are face-finished cassimeres, although they are known and sold under the name "Covert Cloths."

Regarding the face finish for these fabrics, it may be stated that it is seldom used in its entirety except on the finer grades of cloths. Without doubt the saving in the labor cost in the production of the inferior article is an item which has been taken into close account in laying out these fabrics, and therefore it will be our purpose in this article to treat both the better and inferior grades of cloths, explaining the treatment they actually require, consistent with the cost of production. The better grade of cloth must receive first attention, although so far as the first stages of the finishing process are concerned; *i. e.*, burling and mending, the treatment is nearly the same on all grades.

Covert Cloths are made of double twisted yarns for both warp and filling, and are very firmly and closely woven. The present demands of the market are such that even more stress than formerly is laid upon the strength feature of the cloths and it is of great importance to the finisher that he carefully note this item.

Construction. If goods are laid out as they should be, it will be found upon examination that they are made with what is termed a warp twill; that is, the twill is formed by a preponderance of warp threads. If the cloth is made in this way there will hardly ever be any trouble regarding the strength. If, however, as is often the case, the designer is trying to get the same results with a twill formed by a preponderance of filling threads, or by what is termed a filling twill, there is sure to be a great deal of trouble ahead for the finisher, unless the filling is exceptionally good.

The heaviest strain in the production of a piece of cloth falls upon the warp threads, and therefore these threads are usually made stronger and better than is deemed necessary for the filling threads. Without good warp yarn the production of the looms will be smaller than it ought to be, in addition to producing cloth of inferior quality which creates extra work in the preparatory stages of finishing. Therefore, it will be seen that if there is need of economy it is usually practiced in producing the filling.

Burling and Mending. These operations, especially the former, are too often entrusted to incompetent hands, for it is held by many

that almost any girl can burl goods. This is a fallacy, however, for the saving at the burling table is more than balanced by the claims of the buyer. On these goods all the knots must be drawn to the surface and left there for the shears to cut off. The drawing should be easy and the threads should not be unduly tightened.

The mending process follows burling, and at this point it may be said that it pays to have competent help. On all classes of goods where the several threads of the pattern are to show up plainly the mending process must be very thorough and be performed in such a manner that the face is practically as perfect as it can be made. The goods are then ready for the next step in the process.

Fulling. Before the goods are put into the fulling mill, the listing or selvedge should be very carefully examined for, as a general rule, tightly woven goods have a tendency towards rolling and roping in the mill. It will be found that the looser the listing the faster it will full up, and if it fulls faster than the body of the goods, rolling and roping will at once take place. At this point an ounce of prevention or care will be found to be worth several pounds of cure in the form of hard work in trying to unroll and straighten the selvedges afterward.

If, in the opinion of the fuller or finisher, there seems to be the least tendency toward rolling and roping, the safest plan is to at once tack the goods with very small stitches. While this will not wholly prevent the evil—for in such cases there is nothing which will prevent it—it will make the results very much better than they would be without tacking. After the goods are put into the mill the ends should be properly sewn together with very fine stitches. The use of small stitches is especially important as large and uneven stitches will surely produce streaks on the ends of the goods, which on covert cloths show up very plainly, and will therefore make it necessary to cut remnants from the ends of the pieces when the goods are finished.

Sewing Machines are largely employed to sew the ends together and while they undoubtedly make a good, even and fine seam, there are a few points which make it preferable to sew seams by hand for fulling. A hand sewed seam can be made much flatter than one sewed by machine and therefore will not cause so much pounding in the mill. Pounding is harmful to the machine, for it has a tendency to loosen bolts and nuts, and, unless the fuller is very careful and

examines his machine frequently, there is always danger of damage being done on this account. In addition to this it often happens that through the pounding the threads of a machine-sewed seam become broken and ravel, with the result that the goods are often found lying at the bottom of the mill when they are supposed to be running. This does not necessarily cause any damage but it has a tendency to upset calculations somewhat.

Shrinkage. The finisher should now be ready for the calculations in fulling. It must always be borne in mind that the loss which the goods will sustain during the entire process of finishing must be taken into account at this stage, for there is no other opportunity to make good a loss. Of course, there is no absolute rule in regard to the actual loss which will be sustained, and experience is the only guide that can be relied upon. It is here that experience is of especial assistance in determining beforehand the probable amount of loss to be sustained. The more correctly this is determined, the nearer correct the final results will be.

The actual calculation after the loss has been estimated ought to be sufficiently well known not to need any special illustrations. However, the fact remains that all men engaged in operating fulling mills are not especially fitted, in point of education, to cope with the problem successfully and it usually falls to the lot of the finisher to supply this deficiency. A schedule has been embodied in Part I, of "Woolen and Worsted Finishing," which will be found of especial value to the overseer in that it will lighten his labors materially, and also to the poorly educated fuller in that it will supply his deficiency. In this schedule there may be found the results of calculations covering goods from eight ounces, finished weight, to thirty ounces, and with an estimated per cent of loss ranging from ten to twenty-five per cent. This will be found to embrace nearly all kinds of goods and therefore contains something of value to the worker of most finishing departments.

In this schedule the one using it has to know only three things; *viz.*, the weight per yard from the loom, the finished weight per yard wanted, and the estimated per cent of loss which the goods sustain in the process. In the first column, on the left of each page, will be found the weight of goods from the loom given in ounces and half-ounces per yard. In the spaces at the top of each column of figures

will be found the per cent of loss sustained in the process, indicating that the figures below give the required shrinkage per yard when the loss is as indicated in the space on top. Next, on a line with the weight from the loom, as given in the left-hand column, will be found two rows of figures, the upper one being in common type and the lower one in italics. The figures in the upper row denote the finished weight wanted and the italics in the lower column denote the amount each yard must be shrunk in inches and tenths of inches, in order to produce the weight per yard of the figure immediately above it.

Thus if a piece of cloth is to be fulled which it is estimated will lose twenty per cent in the process, and the weight per yard is 26.5 ounces and the finished weight per yard wanted is 27 ounces, all that has to be done is to look in the column headed by 20% and then follow the left hand column down until the weight per yard from the loom is found. In the 20% column behind 26.5 will be found the figures 22, 23, 24, 25, 26, 27. The latter being the finished weight wanted, the figures immediately below, which are in italics (*7.5*), indicate that each yard of the piece will have to be shrunk 7.5 or 7½ inches in order to produce the desired result.

After one or two trials these schedules will be found of so much assistance in the fulling room and to eliminate such an amount of endless calculation that one will wonder how one ever got along without something of that nature.

The most convenient method of preparing goods for the measuring process in the fulling mill, as has been stated before, is by tying a string in the listing, about one yard from the end and another string exactly one yard from the first one; then measure the strings as the goods shrink until the desired shrinkage has been reached.

Another plan, adopted by many, is to measure off a yard, plus the amount to be shrunk, and to mark this space by strings; then to shrink the goods until the distance between the strings measures just one yard. As will be evident a yard in the latter instance is not shrunk as it ought to be, for if a yard is taken, as in the case noted before where the shrinkage is to be 7½ inches per yard, and the 7½ inches added to the 36 inches measured, it follows that 43½ inches, are shrunk to 36 inches instead of 36 inches being shrunk to 28½ inches as should be done.

With even the closest figuring considerable judgment has to be

exercised at this point to have the pieces come out right as to weight, and the subsequent operations, all of which tend to stretch the goods, will have to be considered. It is therefore always best so shrink the pieces somewhat more than the actual amount figured on in order to provide for this stretch.

For instance, if goods are shrunk three inches per yard in the fulling mill and stretch two inches per yard in the washer, good results cannot be expected. Stretching is something which cannot be calculated accurately; it may be much in one piece and less in another, but if the goods are *set up* in the mill good and strong, that is, somewhat more than is required, they will be very much less likely to stretch, and they will come out nearer right for weight.

Another thing which exerts great influence at this point is the length of the pieces. Uneven length is a fruitful source of trouble inasmuch as it makes it difficult for the fuller to obtain sets which will run well together. Also if a piece of forty yards or more is put in the washer the stretch is likely to be much more than it would if the piece were only thirty-five yards long. There is no good reason why goods should come in this way from the weave room but they often do, which goes to show that uniformity is an element the importance of which does not seem to be understood in some weave rooms at least, and it behooves the finisher to have this condition remedied or to take the blame for unevenly finished goods.

Soap. As a good finished piece of covert cloth requires from four to five hours fulling, the soap question is a very important one. Nothing but a pure palm oil soap should be used on them to insure its easy removal in the washer and the soap should be made heavy enough to last through washing. Four to five ounces of a good neutral palm oil soap and two ounces of pure ammoniated alkali will produce a soft soap which will be found all that can be desired for these goods.

After the pieces have been properly fulled and taken from the mill the first operation should be the removal of the tacking twine, if such has been used, and a thorough opening out of the pieces, after which it is good policy to pull them over a perch and examine carefully. This part of the work should in all cases be performed immediately after they are taken from the fulling mill and before the machine is again started up. If for any reason a nail or some other

hard substance has got into the mill or a nut or bolt has become loosened, thus causing damage to the goods, is should be known and the matter remedied before another set of pieces is spoiled.

Washing. This operation should be conducted with warm water if the facilities are present, and in all cases should be thoroughly conducted. The soap must be well rinsed out of the goods or a good finish cannot be obtained.

After a thorough washing the goods are taken to the rolling or stretching machine and are here tightly rolled up and laid down flat on skids to drain. Lying thus over night they are found to be in the very best condition for the napping process which follows.

Napping. Although teasel gigs are still used to quite an extent for covert cloths, it is evident that the better and more even work produced by the napping machine will eventually drive them entirely out of the finishing room. Of course, various opinions prevail, one being that for fine work the teasel gigs cannot be supplanted by any other machine. This, however, has been disproved and the point will not be taken up further.

The felt may be raised by whatever means are at hand, care being exercised not to strain the cloth unduly nor to pull out too many fibers.

When the felt has been partially raised and combed out, the goods should be taken to the shear and given a good cropping. They should not be sheared too low, but enough runs should be given to make sure that the shearing is even. The cloth is then returned to the napper for the final clearing out process. These goods being made of double and twisted yarns will not show as much felt on the face as one would expect after four or five hours' fulling, but the body of the fabric is well knitted together, making a fabric which will show wearing qualities of superior merit.

After the napping has been completed the pieces are taken to the washer and each piece is given two or three pailfuls of a solution of fuller's earth and allowed to run in this bath for fifteen minutes. It is then rinsed for ten minutes with cold water. The cloth is then taken out of the washer and taken immediately to the wet gig to receive four runs each way, after which it is again tightly rolled up and the rolls stood on end over night. Next morning the cloth is

extracted and dried. After a careful inspection on the back for knots the pieces are ready for steam brushing and then for the final shearing.

The nap is not very thick or heavy, but nevertheless it is best to go down slowly on the cloth and to give plenty of runs. The threads are supposed to show up plump and clear, therefore the pieces will have to be sheared quite low, but in no case should they be scraped, as this will destroy the soft and silky feeling which it has been the aim to obtain.

After shearing the pieces are again given a steam brushing and then a hard pressing with the face up. A steam brushing after pressing practically completes the finishing process and the final operations of measuring, rolling up, etc., are carried out.

This finish will give satisfaction to the most critical buyer and it lends itself admirably to many changes which on some classes may be thought to be beneficial. The cheaper grades of covert cloths cannot, however, be treated in this way, even if it should be thought worth while to spend the required time on them. As a usual thing one of the threads of the double twisted yarns used on the cheaper grades of cloth is white cotton, and the chief object is to bring the goods out as bright and lively as possible. For this reason the chief departure from the previous way of finishing is at the point where the goods come from the washer.

Of course, the fulling operation is not so long as on the finer goods, for the cheaper grades will have to be made more solid in the loom so as not to need the fulling. From one to one and a half hours' fulling is the general rule. Washing follows and is in turn followed by a bath of fuller's earth, the object of which is to improve the feeling somewhat, although it is a difficult matter to make a cotton thread feel as soft as wool.

When the goods come from the washer they are at once extracted and dried; the napping being done in the dry state. Very often the pieces will not be so clear and bright after they are dried as they appear to be when they come from the washer, and especially is this noted when they lie around in a wet condition before being dried. In such cases it is advisable to follow the bath of fuller's earth with a bath of salt water made of about twenty-five pounds of salt to a barrel of water, giving each piece two pailfuls of this brine, and, after letting

them run in it for five minutes, to extract and dry. This treatment makes the goods bright and clean.

The gigging or napping is a short process. The nap will be found to be thin and light, on account of which the threads will show up clear and bright even if the pieces are not sheared so low as the finer grades. In fact it is advisable not to shear them any lower than is actually necessary to make the threads prominent, for every fiber of nap left on the face adds to the soft feeling of the goods.

Much judgment must be used at this point in order to turn out acceptable goods. The pressing must not be so hard as on the finer grades, for to remove the press glaze thus created will mean extra labor and this certainly means extra cost. Therefore they are pressed somewhat lighter and the steaming arrangement usually found on the press is relied upon to remove what glaze has been created.

Although these goods are finished in imitation of a better article they possess certain merits of their own. One peculiar feature about them is that the less work that is expended on them the better they are apt to look when finished, provided the finisher knows where to put in the work and where to omit it. While fine goods require much care in handling, as a usual thing there is little trouble with them, but the cheaper grades cause no end of trouble unless they are handled just right.

NAPPING GOODS FOR A FACE FINISH

There is no doubt that fulling a piece of woolen cloth practically makes a certain kind of finish possible or impossible, as the case may be, therefore it is not well to underrate this part of the finishing process. It is, however, a fact, that even when given the best of foundations for the finish in the fulling process, not every finisher is competent to produce a satisfactory face finish. This is due in a great measure to the fact that very few finishers really understand what is required for a good face finish. The idea that all that is to be done to get a good nap is to break up all the felt on the face of the goods and comb out the fibers carefully is, to say the least, very erroneous, for by doing this the principle of saving fibers to strengthen the nap is lost sight of entirely.

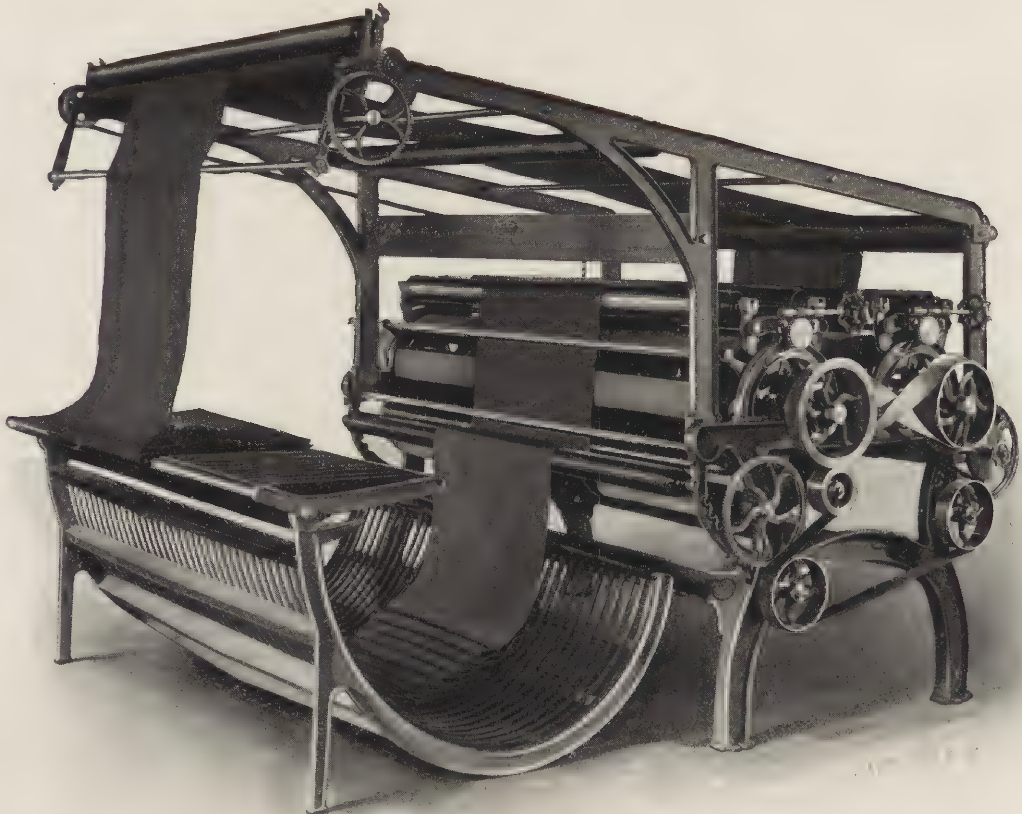
Those who have in a measure learned the advisability of saving fibers are, therefore, much inclined to favor, above any other method, the teasel gig as a means of napping. It is not our purpose to enter into discussion of the merits of types of machines, for this subject has been thoroughly treated before, but we cannot forbear again to point out why the disadvantages claimed against the napping machine are only imaginary.

While it has been proved again and again that the napping machines of to-day are able to produce any desired finish that is equal in quality with the finish produced by the teasel gig, it must also be taken into account that one of the chief points of merit of these machines is the speed with which the work is performed. Even assuming that the quality of the finish should be—as it is not—below that of the teasel gig, this difference is certainly more than made up by the extra amount of production from these machines. The waste is so much less than what is produced on the teasel gig that this point of merit alone will, in the estimation of the finisher who knows the value of fibers when finishing face goods, place the napping machine far ahead of any other agency. Every fiber which is thus saved improves the finish, for it will make the nap just so much thicker.

We must admit that appearances are largely against this contention, but when it is taken into account how much work is turned off by a napping machine in a given time, over what can possibly be produced by the teasel gig in the same space of time, there should be no surprise that more flocks make their appearance than are made by the teasel gig. It is also quite an easy thing to lose sight of the amount of flocks which adheres to the teasels and which is not taken into account.

The grading of the teasels for a good face finish is a very intricate matter and requires not only care but a thorough knowledge of the working capacity of the teasels. And very few men really acquire this knowledge. Therefore the gigging process on face finished goods always has formed the most important part of the finisher's work.

With the napping machine the certainty of having the same napping energy where the same speed of the workers is used, week in and week out, makes it a very much easier matter for the finisher



TWO-CYLINDER SANDING MACHINE WITH OVERHEAD FOLDER AND SCRAY IN FRONT
Parks & Woolson Machine Co.

to produce a uniform finish on his goods, and, once he has established a certain line of action on a given line of goods, he is sure to be able to produce the same result right along, so far as the napping is concerned, and if the finish should not come up to the required standard it is almost certain that he will have to look for the trouble at the fulling end.

All illustrations of how the napping ought to be done must of necessity be based upon the felt the goods have received in the fulling, and for this reason it is often the case that these illustrations do not give the satisfaction in actual practice which is expected of them. While the fulling of goods varies to such an extent that no two mills may be said to work alike in this respect, there is, however, a certain standard which must be acquired by all in order to give good results. This standard is a good, close, and solid felt.

All pieces should be examined carefully before being allowed to pass to the napping process and any which are in the least below the required standard should either be treated separately or, if advisable, be returned to the fulling mills in order to get a better foundation for the napper to work on. If any threads of the fabric are discernable on the face when the piece is ready for napping there is no use to try to get a good face, for a nap cannot be obtained from the thread, and all work expended will weaken the fabric. But if a good close-felted piece is put on the machine the work to get a good nap may be carried on as given in the following illustrations with a certainty of good results.

For example, let us take a well-felted piece of doeskin and put it on the napper. To start with it will be noticed that the nap, if laid, will point in the opposite direction from what we are used to having it on the gig. Hence a change has to be made at the start, the goods being run on the machine in the order that is termed *tail-end first.*

As soon as the piece has been sewed on the leader the speed of the workers is attended to, being adjusted so they will revolve at the slowest possible speed. This stage corresponds to the old or worn work on the gig, with the difference that it is more uniform. The piece is then run over the machine, that is, given just one run and then taken off and reversed, that is, turned so that the end which was last in the first operation will be first in the second operation.

The piece is then run over the machine again, having first increased the speed of the workers one step. This will turn the nap in the opposite direction from the first run and is done to get at the fibers, which it would otherwise take a good deal more work to reach. After the second run the piece is taken off and again reversed so that the nap will be laid this time in the same way as at the first run, and after again increasing the speed of the workers the piece is given another run. It is then taken off and sent to the shear for a cropping, which should be thorough but not too low, the main object being to even up the length of the nap before the final work is given.

If the piece is examined, as it should be after every run, it will be found that most of the felt has been combed out and that only a very little remains to be raised from the very bottom. After cropping the piece is returned to the napper and again put on the machine as on the first run, that is, tail-end first, and the speed on the workers is put at the fastest speed obtainable. One run is usually sufficient but on very fine goods it may be advisable again to submit the piece to a cropping, and after that to another run over the napper. The result of this treatment will be a very thick and full nap, such as can be produced on the teasel gig only with the utmost pains and care. If such a piece is put on a double acting napping machine proceed as follows: Place the workers of both series on their slowest speed and after giving the goods one run send them to the shear to be thoroughly cropped. When the goods are returned after cropping the speed of the straight workers is increased one step, but the speed of the reverse worker is not changed. Give another run and crop again and then give one or two runs with the straight workers at their fastest speed and the reverse workers increased just one step. The results thus obtained will delight the finisher.

It should be remembered, however, that it is poor policy to give all goods a certain prescribed treatment for by so doing it will be found that in the end there will be several grades of goods; some being termed "excellent," others "fair," and very often some will be termed "poor." Goods should always be given what they require, no more, no less. If this plan is followed the results will be very much more even and satisfactory. For instance, if it is found that all the felt has been raised on a piece it is poor policy to give that piece any more work or to give it a run with the workers on fast speed, just because

another piece needed this treatment to bring it out right. Never try to improve the nap by working on the thread for that cannot be done and if tried the goods will look very much worse for it in most cases.

Another illustration is the napping of a piece of beaver. These goods most always imply cotton warps and often considerable cotton or other low stock in the filling, more particularly those of the lower grades. As an example we will take a piece of this latter grade. On these goods it is sometimes a very hard matter to produce a good face and also it is oftentimes very hard to get the back covered as it should be. Therefore the napping on these low grades commences in the dry state before they go to the fulling mill. They are given a run on each side with the workers on medium speed, in order to produce something that will felt together and serve as a basis for the finish.

If a double acting napper is used the speed of the workers for this preliminary napping should be placed at the lowest point, but after all, such things must be finally regulated at the machine where the results of the treatment are at once apparent. Very often a controversy arises as to which side should be treated first, the face or the back, but this is really immaterial except as it may fit into a system for the regulation of the work. The general method is to nap the back first.

After the goods have been napped on both back and face they are sent to be fulled and washed. When they are again ready for the napper it is well to give them a light run on the back first with the workers at their slowest speed. When this has been done the back should be carefully examined, as it will be quite a guide to the method which should be adopted for the face. If the back is well covered the face will stand more work than it would if the back is only imperfectly covered, for the latter shows that the felt for a nap to cover the threads is lacking, and if lacking on the back there is no reason to expect it to be much better on the face. Therefore, regulate the face napping according to the results on the back and give one run with the workers on the slowest speed. Then examine carefully.

If there is still any felt left on the bottom give another run without changing the speed of the workers. This run will generally tell what is needed, but in most cases it will be found about all that the

goods can stand, for not alone is a good finish required but the strength of the goods must not be impaired in the least.

The goods should be tested for strength at every stage of the napping and before they go to the napper, for in this way only can the finisher hold sufficient check on the work. When the double acting napper is used on such goods give them a run on the back at the slowest speed of the workers and after examining the back give the goods the same amount of work on the face, not forgetting to examine them carefully for strength.

In most cases one run on the face will be found sufficient but if it is not and the goods show no decrease in strength the face may be given another run in the same way. This will be found to be enough and the goods will be clear with as thick a bottom nap as the nature of the stock will allow.

TROUBLES MET IN THE FINISHING ROOM.

Many difficulties which he is called upon to overcome in some way are met by the finisher, and the frequent recurrence of which he must prevent. Many of these difficulties and troubles are very often due to causes over which the finisher himself has no control; but that matters little, and while in such cases he probably is not in a position to prevent their occurring again at some future time, he is nevertheless called upon to remedy any ill effects which come to his notice.

When the goods reach the finishing department it is of course too late to prevent previous bad work, therefore, all the knowledge and skill of the finisher should be employed to bring the goods out right, or at least as near right as it is possible to get them. That this is, in many cases, a very difficult proposition cannot be denied, but it is in difficult cases that a good finisher shows his value. In case a man is lacking in experience, any kind of trouble he meets should be welcomed as an opportunity to remedy this deficiency.

This article has not been prepared for the purpose of making things easy for the student, for if it were prepared in this manner it would in the end defeat its own purpose. It is intended simply to call attention to and point out the various troubles one is likely to meet, and to the remedies which have been employed by others.

If the student thinks he has nothing to do but apply the remedies suggested he will soon find that while they may fit some cases they will not fit all. The ability to reason backward, that is, from the effect to the cause, is required at all times, and this of course makes it necessary for one to know the effects certain causes are likely to produce.

There are many things which, though trivial in themselves, cause a great deal of trouble. We will not attempt to enumerate them. It will be our purpose to mention some of the more frequent ones and then find their source and give a remedy which has been employed to overcome them and found to be efficacious.

Fulling. The troubles encountered in finishing woolen goods usually start at the fulling process, and at this point several difficulties are often met which fall to the lot of most fullers. The most frequent of these is the knotting and catching up of the goods in the mill. On most of the fulling mills used at present this trouble is not of such great importance for much of the danger of damage to the goods is removed by the use of stop motions with which most of the modern fulling mills are supplied. But even with a stop motion on the machine there is some danger of damage if the fuller does not make sure that the mechanism is in good working order.

When the machine is empty and before putting in another set of pieces, it takes but a minute to test the stop motion and to fix it if it does not work properly. This will take but a few minutes at the most and it is certain that these minutes cannot be employed to better purpose. However, where the machine is supplied with a stop motion and has not the friction clutch pulley, a constant watch has to be kept, for, while the belt travels from the tight to the loose pulley, damage is apt to be done in case the goods catch up.

The causes for the catching up and knotting of goods in the mill are as follows: *First,* the condition of the machine, and *second,* the manner of putting in the pieces. By carefully observing conditions it may be noticed that this trouble does not occur where there is only one piece running on a side and that straight away, but only in cases where there are two or more pieces run on a side of the mill or where the pieces have been doubled. This shows conclusively that there must be a difference in the length of the pieces or that proper care has not been taken to measure the pieces before running them

doubled into the mill. Therefore, if the fuller will make certain that the several pieces are of the same length he will have solved the problem.

It is wrong to think that a difference of one yard in length will not make any great difference in the running of the pieces, for it certainly will and sooner or later the fuller will have this fact impressed upon him. Too much care cannot be exercised on this point, for it will pay for itself in the smooth running of the operation.

Doubling. When pieces are to be doubled the measuring must be done carefully or there is sure to be trouble. Assume that the fuller has been very careful in this respect and that there still is trouble with catching up. In this case the fuller may at once make up his mind that there is no use looking for the cause of trouble in his direction and turn his attention elsewhere. As soon as the mill is empty let it be closely examined and it will be found that either the rolls are badly worn out of true and therefore need immediate attention in the repair shop, or the machine needs levelling up. When these things have been properly attended to things will run along all right and there will be no further trouble.

It shows very little reasoning power on the part of either the fuller or the overseer to run along for months under such conditions and to keep guessing as to what the cause is. There is no room for guesswork in the finishing room for there is a good reason for every trouble that shows itself. It certainly is the duty of the finisher to speedily find out the reason and remedy the trouble.

Next to the knotting and catching up comes the trouble of rolling and roping of the goods in the mill. The cause for this kind of trouble is to be looked for outside of the finishing room and may be readily located either in the weave room or in the designing end of the mill. However, there is no use in putting goods in the mill and expressing surprise when they are found to be rolled into a tight rope for this might have been discovered before the pieces were put into the fulling mill. This trouble is always found on tightly woven goods with a poorly constructed selvedge or list and is due to the list being looser than the body of the cloth, which causes it to full up faster, thus causing the pieces to roll up.

After the pieces are put into the mill and this trouble is discovered there is no other remedy than for the fuller to stop the

machine frequently and overhaul the pieces, shaking them out well. In some aggravated cases it may be necessary to take them out of the mill, open them out well by shaking and running them in again the other end first. By adding a little fresh soap the fuller may be able to get the pieces out correctly. The best plan, however, is to closely examine the pieces before putting them in the mill and if in the opinion of the fuller or overseer there is the least sign that there will be trouble while fulling, they should be tacked with very small and close stitches. The trouble is not entirely done away with by this means, but it is reduced to a large extent.

Cockles. Another trouble met with at the fulling mills is "cockles." It is often maintained that these troublesome things are caused in the fulling process, through what is termed uneven soaping, etc., but this is in no instance the case. Cockles cannot be made in the fulling mill, but they can and will be developed there. They are made before the goods reach the finishing room or even before the goods are woven, but as they cannnot be seen until brought out by the fulling process it seems logical to lay the blame on the fulling.

It is a very hard matter to say what really causes cockles, but without question the most frequent cause is the uneven oiling of the stock. But even if the stock has been carefully and evenly oiled as is now done in up-to-date mills, by means of mechanical oilers, they are apt to make their appearance now and then, especially if the yarn is allowed to lie for any great length of time before being made into goods. If this is the case the oil on the stock will become firmly set and is therefore apt to start unevenly in the fulling process.

If the latter seems to be the cause it may be overcome by making the soap as strong in point of alkali as the fabric will permit. However, alkali as is well known, is a powerful aid in the fulling process and is therefore likely to bring up the goods in width and length before the required amount of felt is produced. In such cases the pieces should be thoroughly scoured before putting them into the mill, when it will be possible to treat them at this point so that the required finish may be obtained.

As stated before, it is often the case that cockles are attributed to uneven soaping in the fulling mill, but a little reflection and investigation must convince anyone that this is only imaginary, for there

is no such a thing as uneven soaping. There is such a thing as insufficient soaping which in some cases is mistaken for the other. No one who investigates will maintain for a minute that insufficient soaping will cause cockles. There is just as much trouble from cockles in places where the latest improved machines for soaping the goods are used as where these machines are unknown.

When goods are soaped by hand in the mill, whatever amount of soap is given them—whether too much or too little—will be distributed evenly over the goods and no one will be able after five or ten minutes running, with the most critical examination, to show a place or places where the goods are either too wet or too dry. It simply cannot be done even if it is carefully attempted.

But if a piece contains cockles it is useless to argue on the soap question for the piece has to be fixed up somehow. This can be done, except in a few aggravated cases, by thoroughly washing the piece and then extracting just enough so that the goods will not drip. This is followed by drying with just enough stretch both ways to thoroughly smooth out all cockles. After this treatment it usually is necessary to again return the goods to the fulling mill for in order to stretch out the cockles the cloth is likely to become too wide.

If the pieces have been thoroughly cleansed there is little likelihood of more trouble. Care must be taken to have them stretched sufficiently to have a perfectly smooth fabric when dry before they are again sent to the fulling mill, and it may be required to wet them out a second time and again dry them with more stretch before they will be smooth enough.

It is not very often that such troubles show themselves and for that reason there are many finishers who never have had any experience in this line, but when cockles do make their appearance a rigid investigation should at once be instituted and the proper remedy applied before the whole department becomes clogged up.

Mixed Filling. The mixing of filling in the weave room often causes very bad work especially on fabrics which need much fulling, for the fillings being often of different stock with either more or less twist, the goods cannot help but full unevenly or at least shrink unevenly. In most cases this is readily detected for the difference will be noticed on the pick straight across the goods. This trouble simply cannot be remedied and it is useless wasting time trying to do so.

It sometimes happens that the fuller is unable to shrink the goods sent to him sufficiently in length, because they run up too rapidly in width. In such cases the only remedy to employ is to give the goods as little pressure under the roll as possible by loosening the springs attached to the top rolls. When this has been done the fuller has exhausted all means at his command to remedy the evil and the pieces will have to go as they are. A little care on the designer's part might have prevented such a state of affairs but after the goods are woven it is too late to apply a remedy.

All these are troubles which may be met with now and then, and it is well to have some idea of how to take hold and correct things. One thing is certain, however, that the man who will use his brains and reason properly from the effect to the probable cause, will in all cases make a better and more successful overseer than the man who resorts to guesswork or who hunts around trying to find some one to tell him what the trouble is. The troubles to be met with on the shear and press in the subsequent processes are more of a mechanical nature and are thoroughly explained elsewhere.

VIEW IN AN UP-TC-DATE MILL SHOWING PROVIDENCE MACHINE COMPANY'S ROVING FRAMES

THE EFFECTS OF HUMIDITY ON YARN.

The question of humidity is a very important one and is often not given the proper consideration. It is well known that cards, drawing frames, fly frames, spinning frames and looms, especially the latter, run to the best advantage, in regard to the percentage of breakages, in a warm atmosphere which has a considerable quantity of water held in suspension in the form of vapor; in other words, a hot, moist air.

The actual amount of moisture in the air is indicated by the weight in grains of the vapor in a cubic foot of air. The degree of humidity is expressed as a percentage of the maximum amount of vapor the air will hold at that temperature, and is called relative humidity. Any increase in the temperature of the air increases its capacity to hold moisture and, although the actual amount of moisture in the air may be the same, the relative humidity would be less. Air at a temperature of 60° F., with an actual humidity of 3.19, would have a relative humidity of 53. Now take air at a temperature of 72° F., with an actual humidity of 3.19, and the relative humidity would be only 35. That is, the air at the two different temperatures contains the same amount of moisture, 3.19 grains per cubic foot, but the relative humidity is 18 degrees less with the higher temperature.

It is well known that spinning frames run better when the air is damp and hot, but are there any other advantages in having these conditions, and, if so, what are they?

It was with this object in view that the following experiments were made; the results were a little surprising. After getting along in the work and finding that the humidity did have a great effect on the yarn, an attempt was made to determine just where the best results were obtainable.

The cotton selected for these tests was Middling Uplands of one inch staple, and Peelers of one and one-quarter inch staple;

the longer stapled cotton being used to spin the higher numbers. The tests covered a long period of time, extending through the winter and into the summer of three years, giving results obtained under all atmospheric conditions, varying from hot, dry, windy weather to cold and damp days, when there was no wind. This was to determine whether the outside atmospheric conditions would have any effect on the yarn, provided the conditions on the inside were the same. So far as could be noticed this made no difference in the results, as the same lot run when the air on the oustide was hot and dry gave practically the same result as when run while the outside air was damp and cold, the conditions on the inside being the same in both cases.

In most of the tests the humidity was obtained through artificial means, by using humidifiers, though a great many of the lower humidities were natural. The temperature of the room during these tests varied from 65 to 85 degrees, no attempt being made to keep the temperature in the different tests the same. So far as could be seen, this change in temperature did not have any effect on the yarn, as two tests on yarn of the same size, run at the same humidity but at temperatures of 68 and 83 degrees, gave only a variation of 1½ pounds in the average breaking strength and no difference in the appearance or running.

In preparing the roving, care was taken to have it all made under approximately the same degree of humidity and the machinery was in as good working condition and adjustment as it was possible to get. The variation in the humidity was made only while the yarn was being spun. Twenty bobbins were taken as a basis for getting the averages and this number was not any too large. These twenty bobbins were selected from eighty bobbins on the frame without any regard to their positions, so as to get as good an average as possible.

The humidity was carefully watched and recorded, readings being taken every ten minutes during the running of the test, the respective humidities given being the average of the readings for that test. These readings never varied far from the averages given. Different frames were run with the different sizes of yarn, giving different speeds and sizes of rings as the yarns increased in counts. Each test was run 1½ hours.

The following tables give the results:

TABLE GIVING THE HUMIDITIES AND BREAKING STRENGTH FOR 20s YARN

Average Humidity	Average Breaking Strength
Test No. 1, 40	82.4 lbs.
Test No. 2, 45	85.5 lbs.
Test No. 3, 50	89.6 lbs.
Test No. 4, 55	92.5 lbs.
Test No. 5, 63	95.6 lbs.
Test No. 6, 70	98.7 lbs.
Test No. 7, 81	101.5 lbs.

Difference in humidity, 41
Difference in breaking strength of yarn, 19.1 lbs.

TABLE FOR 25s YARN

Average Humidity	Average Breaking Strength
Test No. 1, 40	65 lbs.
Test No. 2, 45	64.4 lbs.
Test No. 3, 49	63.7 lbs.
Test No. 4, 55	66 lbs.
Test No. 5, 61	69.6 lbs.
Test No. 6, 70	70.1 lbs.
Test No. 7, 75	73 lbs.
Test No. 8, 84	75.2 lbs.

Difference in humidity, 44
Difference in breaking strength of yarn, 11.4 lbs.

TABLE FOR 30s YARN

Average Humidity	Average Breaking Strength
Test No. 1, 46	44.4 lbs.
Test No. 2, 47	43 lbs.
Test No. 3, 57	48.1 lbs.
Test No. 4, 60	53.8 lbs.
Test No. 5, 63	54.6 lbs.
Test No. 6, 66	53.8 lbs.
Test No. 7, 70	54.5 lbs.
Test No. 8, 75	55.6 lbs.
Test No. 9, 80	57.3 lbs.
Test No 10, 85.3	59.3 lbs.
Test No.11, 95	63.6 lbs.

Difference in humidity, 49
Difference in breaking strength, 19.2 lbs.

TABLE FOR 35s YARN

Average Humidity	Average Breaking Strength
Test No. 1, 39	41.3 lbs.
Test No. 2, 44	40.1 lbs.
Test No. 3, 50	42.6 lbs.
Test No. 4, 56	44.5 lbs.
Test No. 5, 60	47 lbs.
Test No. 6, 66	50.5 lbs.
Test No. 7, 68	49.7 lbs.
Test No. 8, 73	53 lbs.
Test No. 9, 78	54.6 lbs.
Test No.10, 84	55.7 lbs.
Test No.11, 86	56.2 lbs.

Difference in humidity, 47
Difference in the breaking strength of yarn, 14.9 lbs.

These experiments included 40s, 45s, 50s, 55s and 60s carded yarns, but it is sufficient to say that the general results were the same, without giving all the tables. The draft on the spinning frames in all the tests was 10, so as to have no difference in the breaking strengths due to different drafts.

In almost every case the higher the humidity the higher the breaking strength in all tests with all the sizes spun. As was expected there were some exceptions to this, but the tables show that this holds good in most cases, and in every test there was a difference in the breaking strengths between the lower and higher humidities in favor of the latter. The difference in the weights of the yarn spun under the high and low humidities was not enough to be taken into consideration.

It was noticed also that the ends stayed up best when the humidity was between 65 and 75, and above and below that the percentage of broken ends was greater. There were one or two exceptions to this rule.

A comparison was also made as to the appearance of the yarns spun under the different humidities and in practically every case those spun with the higher humidity showed up best. By this is meant that the yarn under the microscope looked a great deal more compact, as will be seen by the cut Fig. 1.

Fig. 1.
Showing difference in appearance of yarns spun at humidity of 80 and 45.

The yarn on the left was spun with the humidity at 80, while that on the right was spun with the humidity at 45, both being of the same counts. The yarn spun at 45 humidity appears about twice as large as the one spun at 80, but there is no difference in the counts of the two yarns.

After the humidity was raised to 65 and 75 it was almost impossible, in many cases, to distinguish them by any such difference. That is, take the yarns of the same size, spun with 70 and 85 humidities and there was no difference in their appearance under the microscope. There

were probably not less than one hundred mountings of these samples made to test this difference, and over two dozen photomicrographs taken from these mountings. It is necessary to give but one of these photomicrographs as the others would look very much the same and simply amount to a repetition, except when the humidity was 70 and over, when they would have nearly, and often, the same appearance.

Care was taken in making these mountings not to get results that were incorrect. In some cases, with the lower numbers, the difference in the appearance in the yarn was so marked as to be easily seen by the naked eye. It was also noticed that there was less fly on the frames when running with the higher humidities, showing conclusively that there was not the tendency for the fibers to separate from each other to such an extent as when the humidity was low, hence tending towards the making of a smoother yarn.

The conclusions that are to be drawn from the experiments are:

First. As a rule the higher the humidity the higher the breaking strength of the yarn.

Second. That the percentage of broken ends was less with the humidity at about 65 to 75.

Third. The fibers in the yarns lay closer together as the humidity was increased, producing a more compact and less "fuzzy" yarn, also a yarn that looked smaller. After the humidity was raised to about 70 there was scarcely any difference in the appearance in the yarns.

Fourth. The higher the humidity the less fly collected on the frames.

From these four conclusions it would appear that, all things being taken into consideration, a humidity between 65 and 75 would give the best results in the spinning room. Above this a little stronger yarn might be obtained but its appearance would not be any better and the chances are that broken ends would increase in number.

REVIEW QUESTIONS.

PRACTICAL TEST QUESTIONS.

In the foregoing sections of this Cyclopedia numerous illustrative examples are worked out in detail in order to show the application of the various methods and principles. Accompanying these are examples for practice which will aid the reader in fixing the principles in mind.

In the following pages are given a large number of test questions and problems which afford a valuable means of testing the reader's knowledge of the subjects treated. They will be found excellent practice for those preparing for Civil Service Examinations. In some cases numerical answers are given as a further aid in this work.

REVIEW QUESTIONS

ON THE SUBJECT OF

WOOLEN AND WORSTED FINISHING.

PART I.

---

1. Describe the process of finishing, up to this point, of a piece of all-wool fancy cassimere weighing from the loom 21 ounces and which is to be finished 23 ounces; do not speck-dye the goods.

2. Why is a system of grading flats necessary?

3. What purpose does speck-dyeing serve?

4. (*a*) After goods are napped, which process generally follows?

   (*b*) What other process may take its place, and on what kind of goods?

5. How should goods be put into the fulling mill to full quickly?

6. Of what use is alkali in fulling soap?

7. How do the napping rolls act on the cloth?

8. What is the composition of potash soap, and how does it differ from other soaps?

9. (*a*) What is the chief characteristic of a potash soap?

   (*b*) Why is it not more used?

   (*c*) Is it beneficial to goods or otherwise? Why?

10. What effect has soda soap on the wool fiber?

11. Describe the manner of grading flats.

12. Which is to be preferred for use on woolen goods, potash or soda soaps?

13. What is the object of steaming goods, and what other means may be employed to obtain the same result?

14. Can goods be washed without the use of warm water, and in the event of your thinking that they can, how would you proceed?

15. Give your views as to a system of grading teasel flats.

16. Give directions for preparing a batch of speck-dye to stand at 24° Baumé.

17. Describe the process of napping.

18. Should goods be subjected to stretching?

19. Is the use of flocks beneficial to goods? Give your reasons for or against.

20. What kind of gig will do the most work? Why?

21. Why are traps used in fulling mills?

22. (*a*) Describe the process of washing worsteds.

(*b*) What ingredients are preferably used?

23. Why is singeing employed on goods? What class of goods are generally singed?

24. Why are stretching machines used?

25. Is singeing of benefit on men's wear worsteds? Why is it, or why is it not, of benefit?

26. Describe the singeing machine which you consider best for this purpose, from illustration, using your own words.

27. Which of the different machines for fibre raising is in your estimation the best to use, and why?

28. How should the shrinkage be regulated so as to be of most advantage to the goods?

29. What is the object of crabbing, and where is it mostly used?

30. In making weight in the fulling mills with flocks, which is the best way to proceed? Describe carefully.

31. Of what does the gigging process consist?

32. How should teasels be mounted? How are they used?

33. How should cloth be put on the napper, and why?

34. What is the process omitted when goods are steamed?

35. How many different kinds of machines are used for gigging?

REVIEW QUESTIONS

ON THE SUBJECT OF

WOOLEN AND WORSTED FINISHING.

PART II.

---

1. What are the two methods of drying?
2. What are the conditions necessary for successful drying?
3. What is the principle upon which the new pneumatic extractor works?
4. On which class of goods is this extractor of special benefit? Why?
5. Why is dry-beating advisable and on what kind of goods?
6. What is required of a shear tender?
7. What are the various troubles met with in shearing?
8. Why do they occur, and how can they be remedied?
9. How should the list motion be kept in order?
10. Why is flake graphite to be preferred to oil?
11. When sewing the ends together how should the seam be made by machine?
12. Which is the most frequent cause of pulling or skipping, and how can it be avoided?
13. What is meant by the term "notches"?
14. What is the first thing to be done when the shear is to be ground?
15. How do you find if the ledger is even or not?
16. How is it found on the revolver?
17. What kind of oil is best adapted for the shear?
18. What size emery is used for grinding?

19. How is the blade relieved from the pressure of the revolver or cylinder without resorting to the grinding process?

20. Why will this increase the cutting quality of the blades?

21. Should the flocks be removed from between the knives of the revolver?

22. How long is it advisable to grind a shear?

23. How should the brushes be treated?

24. How should they be used? Why?

25. Explain the working of the list-motion and name the several parts of which it is composed.

26. Why is the "rubber rest" so named?

27. Explain the cutting arrangement of the rubber rest shear.

28. Rubber being an unreliable material, how is the "rest" kept true?

29. What points are mostly to be looked after concerning the apron?

30. Of what material is this apron made?

31. When grinding the rubber rest shear, how are the blades brought together?

32. What keeps them in position?

33. How should the cutting part be set, so as to give the best results?

34. What point should be noted especially in regard to tubes?

35. Why are goods pressed?

36. How should the pieces be run over the press and why?

37. How should the pressing be conducted to give a good, lasting finish?

38. Why do goods need doubling and when?

39. If this is done by hand, which is the best way to do it?

40. Describe the different ways in which goods are handled at the final stage, making use of the several machines illustrated.

REVIEW QUESTIONS

ON THE SUBJECT OF

WOOLEN AND WORSTED FINISHING.

PART III.

---

1. Give a description of finishing a piece of low-grade cassimere, which loses 25 per cent in finishing, weight 22 ounces from the loom, and is to finish 21 ounces, to receive 3-inch shrinkage per yard, and the rest of the weight to be made up by flocks. Piece is $24\frac{1}{2}$ yards from loom. Give a detailed account of all the processes the piece passes through, how it is handled at each process. How much flocks it requires in pounds and ounces, how the flocks are put on, in fact the whole process from beginning to end, that is from loom to case.

2. What difference do you note in the process of finishing cassimeres and kerseys?

3. What is the chief characteristic of Thibets?

4. What are the chief characteristics of serges?

5. How are satinets usually finished?

6. What kind of machines are used in the finishing of dress goods?

7. Explain the nature and use of the crabbing machine.

8. In what respect is the new wet-finishing machine an improvement over the old-style crab?

9. In singeing dress goods, what methods are employed?

10. Which is the best method and why?

11. Explain the uses of a padding machine.

12. Before the goods go to the dyehouse what precaution is generally taken and why?

GENERAL INDEX

GENERAL INDEX

In this index the Volume number appears in Roman numerals, thus —I, II, III, IV, etc.; and the Page number in Arabic numerals, thus— 1, 2, 3, 4, etc. For example, Volume IV, Page 327, is written IV, 327.

The page number of each volume will be found at the bottom of the page; the numbers at the top refer only to the section.

Note.—For page numbers see foot of pages.

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Arithmetic Part III.
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*Mechanics Part II.
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Woolen and Worsted Spinning Part IV.
Warp Preparation.
Weaving Part I.
Weaving Part II.
Weaving Part III.
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Textile Design Part IV.
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Textile Chemistry and Dyeing Part I.
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Textile Chemistry and Dyeing Part III.
Textile Chemistry and Dyeing Part IV.
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Boiler Accessories.
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The Steam Engine Part II.

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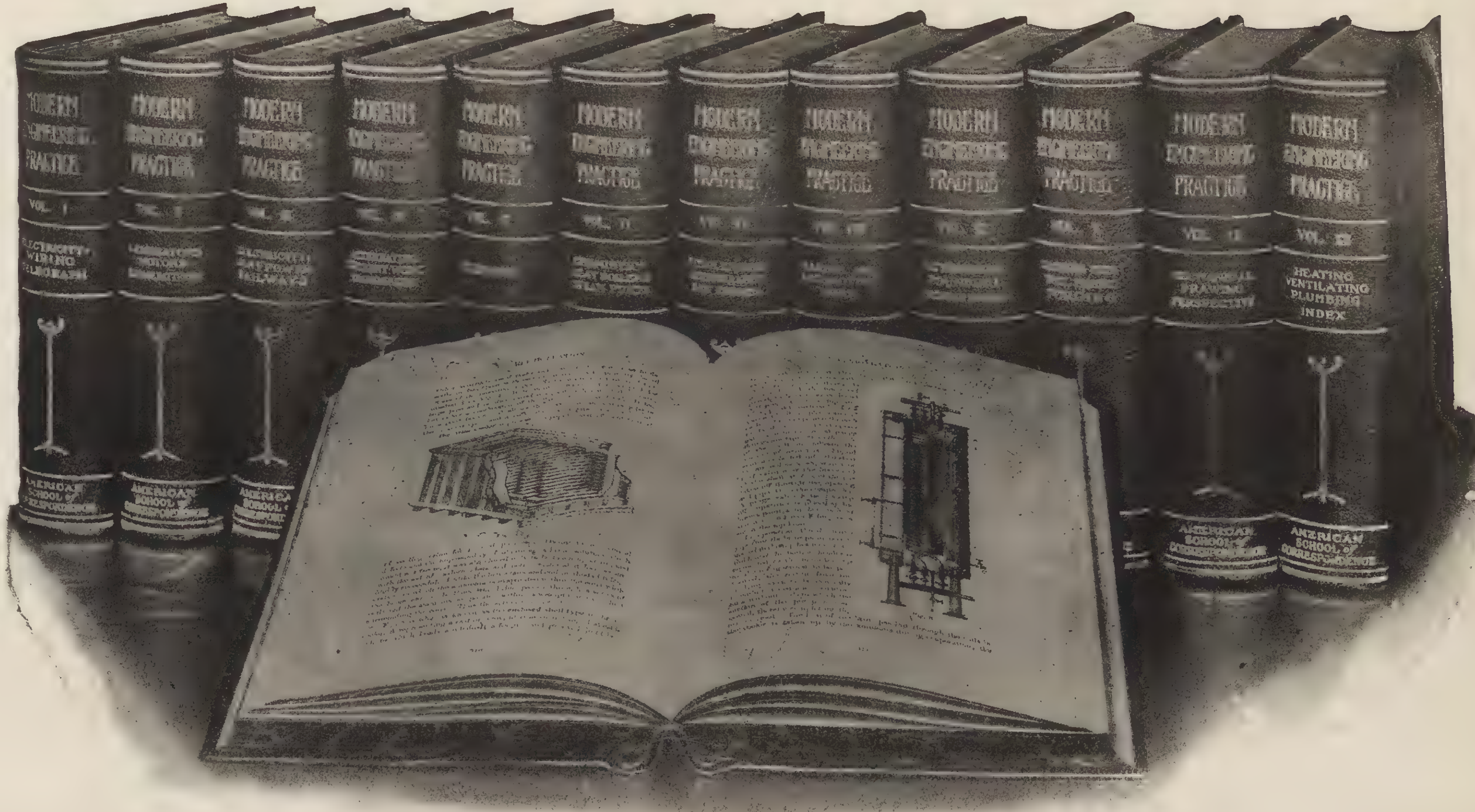
Elements of Electricity.
The Electric Current.
Theory of Dynamo-Electric Machinery.
Direct Current Dynamos.
Direct Current Motors.
Types of D. E. Machinery.
Electric Lighting.

The above is typical of the ground covered in the complete courses. **For list of the other courses in the Textile Department, see page 322.**



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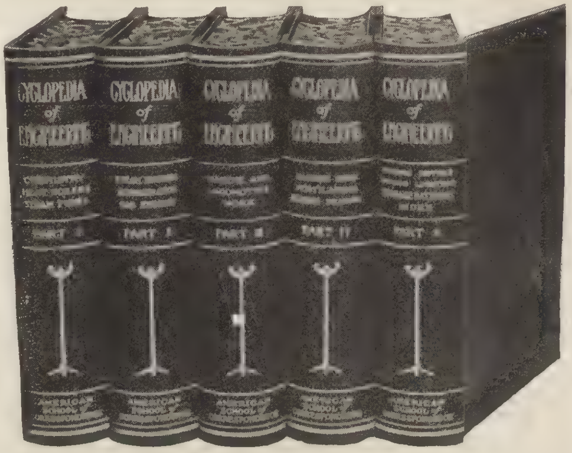

PARTIAL TABLE OF CONTENTS

Part I. Heat—Chemistry—Construction of Boilers—Types of Boilers—Boiler Accessories—Steam Pumps—Elevators.

Part II. The Steam Engine—Indicators—Valve Gears—Thermodynamics—Refrigeration—Gas and Oil Engines.

Part III. Marine Boilers—Marine Engines—Condensers—Navigation—Locomotive Boilers and Engines—The Air Brake—Automobiles.

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Frederick W. Turner, Instructor in Machine Shop Work, Mechanic Arts High School, Boston.

Lionel S. Marks, S. B., M. M. E., Assistant Professor of Mechanical Engineering, Harvard University, American Society of Mechanical Engineers.

John Lord Bacon, Instructor in Forge Work, Lewis Institute, American Society of Mechanical Engineers, Author of "Forge Practice."

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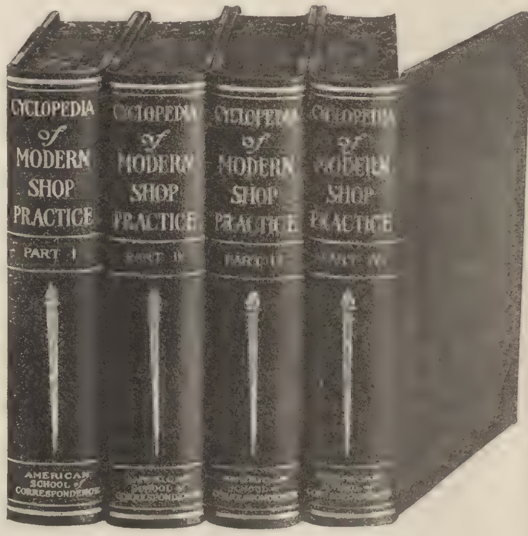

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